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ABSTRACT

This curriculum guide is the third (Series III) in a six-volume set that comprises the Sea Week Curriculum Series developed in Alaska. The book lends itself to the second-grade level but can be adapted to preschool, secondary, and adult education. Ten units contain 77 activities with worksheets that cover the following topics: (1) introduction to mollusks; (2) bivalves; (3) univalves; (4) chitons; (5) cephalopoda; (6) seashell field trip; (7) mollusks to insects: water invertebrates; (8) freshwater insects; (9) freshwater field trip; and (10) field trip follow-up and review activities. An introduction provides information designed to help teachers become familiar with the contents of the curriculum guide and to assist in planning. Each unit contains information on student objectives, and activity background, vocabulary, materials, and procedure. Activities engage students in interdisciplinary projects that involve the skills of classifying, identifying, comparing, computing, measuring, game playing, role playing, writing, communicating, imagining, observing, recording data, and investigating. An annotated bibliography contains 132 resources. A packet of teacher reproducible worksheet masters accompanies the curriculum guide. (LZ)

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alaska sea week

Curriculum Series: III

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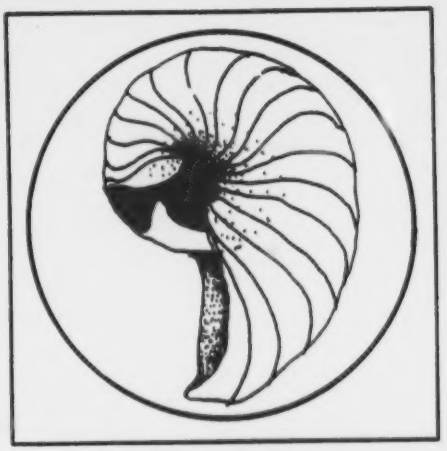

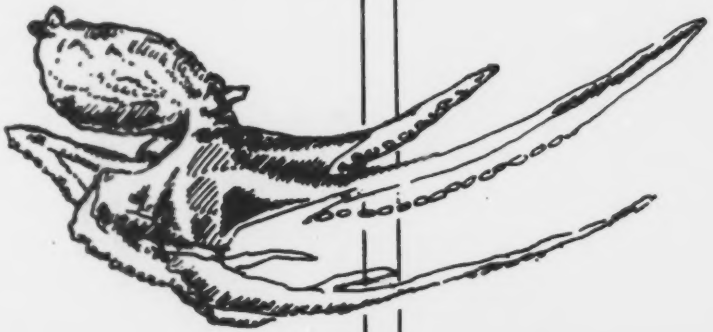

Shells and Insects

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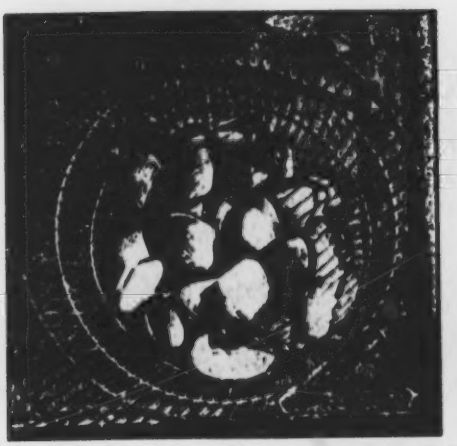

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Alaska Sea Grant College Program
University of Alaska
Fairbanks, Alaska

Alaska Sea Week Curriculum Series: III

Shells and Insects

By:
Claudia Kelsey
Mary Beth Parsons
Margaret Cowan

with:
Judith Anderegg
Susan Baxter
Veronica Franceschini

Editors:
Grant Sims
John Creed

Illustrators:
Rene Patton
Claudia Kelsey
Karen Stomberg

Graphics and Layout:
Karen Stomberg

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Introduction

Sea Week is a celebration. It's one of those rare school programs that can saturate a class with learning opportunities without intimidating a single child. The hundreds of teachers now participating in Sea Week throughout Alaska have found it to be a highlight of the year--a week of delight and awe, intrigue and excitement. It's a week that translates classroom science, mathematics, language, history, social studies, art and music into the crash of a wave, the scuttle of a crab, the drift of a kayak, the bark of a sea lion, the taste of smoked salmon, the scent of a pier. The only frustrations we've found are among educators who discover that a week isn't enough. Many teachers have expanded their programs to a month. Several have simply given up on trying to confine Sea Week to a time, and now make use of the curriculum throughout the year. However you design your own program, we're confident that its primary ingredients--Alaska's kids and coastlines--come to you satisfaction guaranteed!

Shells and Insects is the third of seven Sea Week curriculum guides. The book lends itself well to a second grade curriculum, but is not "locked" into that grade level. It has been adapted effectively to preschool, secondary and adult education. Several factors are responsible for the versatility. One is that while student activities in each book are at grade level, the teacher background materials are written at university level, and can be transferred to the classroom at any level the teacher desires. Another is that the curriculum encourages the use of community resource experts, who can gear their talks and tours to anyone from preschoolers to retirees. A third reason for the flexibility is that many of the student activities have latitude. When in Volume VI the guide suggests building model boats, for instance, it includes the pattern for a paper cutout. But the same activity can be used by high schoolers constructing complicated models, or by adult students trying their hands at building an actual kayak!

The lives of all Alaskans are touched often by the sea--literally, aesthetically, productively. To begin with is the sheer immensity of the Alaska coastline. It stretches and twists, pounds and lies placid along two oceans and three seas for 6,640 miles--more than half that of all the contiguous United States. Islands, inlets, bays, fjords and delta regions add another 28,000 miles of saltwater shoreline for a total of 34,640 miles--a distance almost equal to twice the circumference of the earth. Alaska's continental shelf covers more than 830,000 square miles, which is more than 75 percent of the U.S. total. More than 90 percent of the fish caught in the U.S. come from Alaska waters. And Alaska's coastal zones, both onshore and offshore, contain an estimated 75 billion barrels of petroleum and 380 trillion cubic feet of natural gas--amounts that would equal 50 percent of the nation's remaining petroleum reserves.

More than three-quarters of Alaska's almost half-million people live along its coastline. Their careers are generally sea-related. Grocers sell to the fishing fleet, lumbermen float their log rafts oversea to the mill, real estate salespeople get more money for property with an ocean view, and school teachers find that one of the most effective ways to spark interest in a child's eyes is to turn those eyes seaward.

The bulk of Alaska's culture is so closely interlaced with the sea that in many cases the sea is Alaska culture. The seven volumes of the Sea Week Curriculum Series escort youngsters through the crafts, arts, music and oral and written literature of the coastal Haida, Tlingit, Koniag, Chugach, Aleut, Yupik and Iñupiat, as well as through the poetry, literature and artwork of Alaska today.

And even the lives of that one-quarter of Alaska's folk who don't live along the coastline are linked to the sea. They are consumers of sea products, of course; and beneficiaries of seacoast oil wealth, and even occasional visitors to the sea. But more importantly, they are linked to the sea by Alaska's myriad rivers and wetlands. Alaska's vast interior, which its inhabitants call "The Golden Heart" of the state, includes hundreds of thousands of miles of rivers and streams, and 390,941 square miles of wetlands. That's two-thirds of the state, all linked to the coastline by freshwater systems that serve as nurseries for Alaska's salmon and waterfowl, as transportation arteries to and from the coast, and as the nutrient-rich replenishers of the ocean currents.

Because of such interconnections between wetlands and the sea, with this edition the Sea Week Curriculum Series has been expanded to include units on Alaska's wetlands, as well as the traditional Athabascan and contemporary peoples who inhabit them.

The resulting series is the foundation of the most comprehensive marine education program ever developed in the Northland. We hope that you will find it as valuable and motivating as it is intended. We hope, too, that through Sea Week, the youngsters of your classrooms will come to more deeply respect and appreciate the environments for which they will soon be responsible. The insights they gain in your classrooms will become the votes and legislation, the lifestyles and attitudes, the wisdom and understanding--the sea harvest--of tomorrow.

Tips for Teachers

Welcome to Sea Week! Here's a checklist of tips designed to help familiarize you with the contents of Shells and Insects and to assist your Sea Week planning.

In Your Classroom

- If you haven't scanned the book already, we suggest you get a sense of its format by glancing through the Table of Contents, the different units containing teacher background and student activities, the student worksheets, and the bibliographies at the end of the shell and insect sections. Note that each unit begins with a list of objectives that specify which activities are designed to accomplish those objectives.

- Student worksheets have been placed together at the end of the book. But they are numbered to correlate to the units they complement. Thus Worksheet 1-A is the first worksheet (A) listed among the activities in Unit 1; Worksheet 2-C is the third worksheet (C) assigned in Unit 2, and so on. Some teachers like to copy the worksheets en masse and bind them into student activity books. Others prefer to insert the worksheets into the corresponding units of the text, then distribute them one by one as the appropriate topics are covered.

- Asterisks are used in the Table of Contents to indicate the most representative activities of each unit. Many teachers use the curriculum guide throughout the year, but others find their time limited. The asterisks are planning aids for those designing a compressed Sea Week program.

- This book focuses on two groups of aquatic invertebrates: shells and insects. Units One through Six deal primarily with saltwater environments and the mollusks. Units Eight and Nine focus on freshwater environments and insects. Unit Seven provides background on all water invertebrates and serves as a link between the saltwater and freshwater sections. Unit Ten reviews all the material. You may want to introduce both insects and shells during Sea Week, using parts of each section; or you may prefer to study one group in depth, or study shells in the fall and insects in the spring, or vice versa.

- Make lesson plans. Preview the units thoroughly, selecting those activities most appropriate for your students, considering local history and culture. You may want to juggle the order of the units to suit your existing class format. Note that we've included activities to sharpen skills in language arts, science, social studies, math, music, art and physical education, so that all aspects of education during Sea Week can focus on Alaska's ocean, river and wetland environments.

- Check through the materials list for each activity, then make, buy, scrounge or order any equipment you might need.

- Order films early!

- Talk to your librarian about books to back up your studies. See this volume's bibliographical entries for suggestions.

In the Field

- Plan your field trips. Decide on locations, times and means of transportation. Arrange to take parents, older students or resource people as helpers. The most successful trips usually have one adult per five or fewer students. Biologists, long-time residents, parents, or bilingual staff may have field-trip suggestions. Invite one or more of these resource people to go along. Usually, they're more than happy to oblige.

- Develop a field trip outline. Suggested inclusions:

  A. Discovery and exploration time.

  B. Structured learning activities.

  C. Snacktime.

  D. Organized games, treasure hunts, litter pickup.

  E. Review (which can be as simple as having each student and parent telling what he or she enjoyed most).

  If you're taking a bus, make up a game or checklist of things to watch for to develop a learning atmosphere for the trip. See sample checklist on page xvii.

- Write a letter to parents. Include requests for field trip assistants, resources, ideas, and permission slips.

Dear Parents:

We are celebrating Sea Week May 6-11. All our classes that week will focus on the sea. We'll be emphasizing shells and insects as we compute sea-related math problems; write sea themes; read sea stories; have a seafood snack and take a field trip to the beach. Can you:

[ ] provide a seafood snack.

[ ] help with the field trip.

[ ] assist with a Sea Week art project.

[ ] talk to the class on the following sea themes: _____
_____.

[ ] show the class your collection of _____.

[ ] help with Sea Week planning.

Thanks so much! And happy Sea Week!

I give my permission for _____ to go to Icicle Seafoods Cannery one day (depending on weather) during the week of May 6-11.

_____
signature

- If at all possible, visit the field-trip site ahead of time with your assistants. Explain what you'll be doing and answer questions. (Older students make great helpers, in addition to parents and interested community members.) Field trips generally work best if you can divide your students into groups of five to six.

- Promote conservation: the protection and wise use of natural resources. Ask children how they can help take care of animals and plants they encounter in their field and classroom studies. Through their concern for life and habitat, have students develop some rules: step softly and quitely while observing animals, replace rocks or logs after looking underneath (to keep the roofs on animal homes), handle animals gently, fill in holes after looking for clams (to prevent suffocation of the animals next door), and don't take live animals or plants away from their homes.

- So that future children can enjoy the area, too, it is a good idea to discourage personal collections of any natural items, living or nonliving. Limit collections to educational purposes such as art projects or aquarium study-- and return any living animals to their natural habitats as soon as possible. For classroom specimens, preserve only those animals already dead.

- Encourage students to leave the beach, river or wetland cleaner than when they arrived.

- Remember safety. For field trips, have a plan for keeping students in groups through a buddy system or adult supervision. Take a first aid kit. Discuss hypothermia. Take matches and tinder for starting a warm-up fire if necessary. Make sure students dress warmly and take extra clothes and rain gear (plastic trash bags will do in a pinch). And wear life jackets on boat trips.

In Your School and Community

- One of the best parts of Sea Week is involving all the students, teachers and community residents so that everyone works together. The whole school is decorated; one class inspires another; older students do programs for younger ones and vice versa; community residents help with field trips and speakers; and an air of excitement prevades halls and classrooms! But don't hesitate to try Sea Week on your own or with a few other teachers. By next year, when they've had a chance to see what you've done, others will be ready to try Sea Week, too!

- Plan your school's Sea Week at a time best suiting your location. Teachers in southwestern, southcentral and southeastern Alaska are finding it best to consult tide tables and plan beach trips at low tide. In northern, central and western Alaska, Sea Week proves most successful when

there's open water, or when they are planned to coincide with long-standing community fishing or whaling seasons and celebrations.

- Brainstorm Sea Week ideas with other teachers and parents. Use the Sea Week Planning Sheet beginning on Page xv to list the names of parents and local resource people who can help make your Sea Week a success. You'll find most people pleased to be asked, and more than happy to help.

- Involve your bilingual staff as you identify such community resources as speakers (fishermen, net menders, Coast Guard personnel, boat captains, elders, artists, musicians) and field trip sites (beaches, harbors, canneries, seafood markets, salmon spawning streams, marshes, hatch-). eries, museums).

- Parents or teachers can be appointed to coordinate speaker schedules, movies and field-trip transportation, and to present your Sea Week plan to school district officials for approval.

- Contact community groups, your chamber of commerce, village council or borough government, and invite them to sponsor complementary Sea Week events such as festivals, seafood dinners, slide shows, speakers.

- If your school is inland, consider exchanges with coastal schools. Send them a selection of items found on your field trips, a class story, or perhaps photos. Maybe they can send you fish stories, pieces of net, floats, seaweed, beach sand. Most activities in this book easily can be adapted for inland schools. Try to get a saltwater aquarium for your school.

- Field trips and other Sea Week activities make bright news features. Consider contacting your local newspaper, television or radio station. Teachers usually find that reporters generally enjoy going to the beach as much as the students!

Follow-up

- Write thank you notes to speakers.

- Ask students, teachers, parents and community participants to evaluate Sea Week.

The sea is important to me because...

To me, the best part of Sea Week was...

The part of Sea Week I didn't like was...

My suggestions for making Sea Week better are...

Overall, Sea Week was:

poor

ok

great

- Write a brief report including sample student work, evaluation forms, and news articles for your administrators. Send a copy to Alaska Sea Week. We like to keep informed of what you are doing! And we'll share your good ideas with other students, teachers, and administrators.

- Photocopy your lesson plans and stick them in this guide, so you'll be ready for next year!

- If you'd like to learn more, consider requesting a Sea Week inservice or 1-credit course for your school. Contact Alaska Sea Week, School of Extended and Graduate Studies, Outreach Division, University of Alaska, Juneau, Alaska, 99802, or Talent Bank, Department of Education, Pouch F, Juneau, Alaska 99811, or Sea Week/River Week Project, College of Human and Rural Development, University of Alaska, Fairbanks, Alaska 99701.

Sea Week Planning Sheet

Resource People: Speakers, craftsmen, field trip leaders.

Name	Expertise	Phone

Field Trip Possibilities:

Location	Habitat (Beach, river, pond)	Transportation Arrangements

Volunteers: To help with field trips, seafood meals, classroom activities.

Name	To Help With:	Phone

Films:

Call Number	Title	Source	Rating

Books:

Call Number	Title	Source	Rating

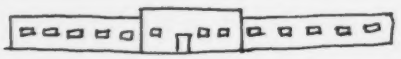
Equipment:

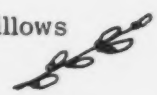
Type	Purpose	Source

CHECKLIST:

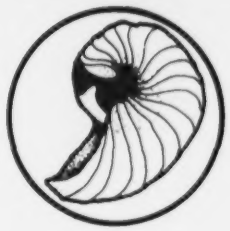
Check off these items as you see them. Circle the ones you might sea at the beach. Happy hunting.

- ☐ seagulls
- ☐ Sea Land van
- ☐ pilings
- ☐ sea otter
- ☐ buoy
- ☐ bus driver
- ☐ litter
- ☐ broken glass
- ☐ bicycle

- ☐ raven
- ☐ cannery 
- ☐ ferry
- ☐ stop sign

- ☐ bridge
- ☐ pussy willows 
- ☐ sea star
- ☐ crab claws
- ☐ skiff

Unit One
Introduction to Mollusks



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Worksheets:
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Mollusk Groups.....1B

Activity 2: Shell Prints ... 6

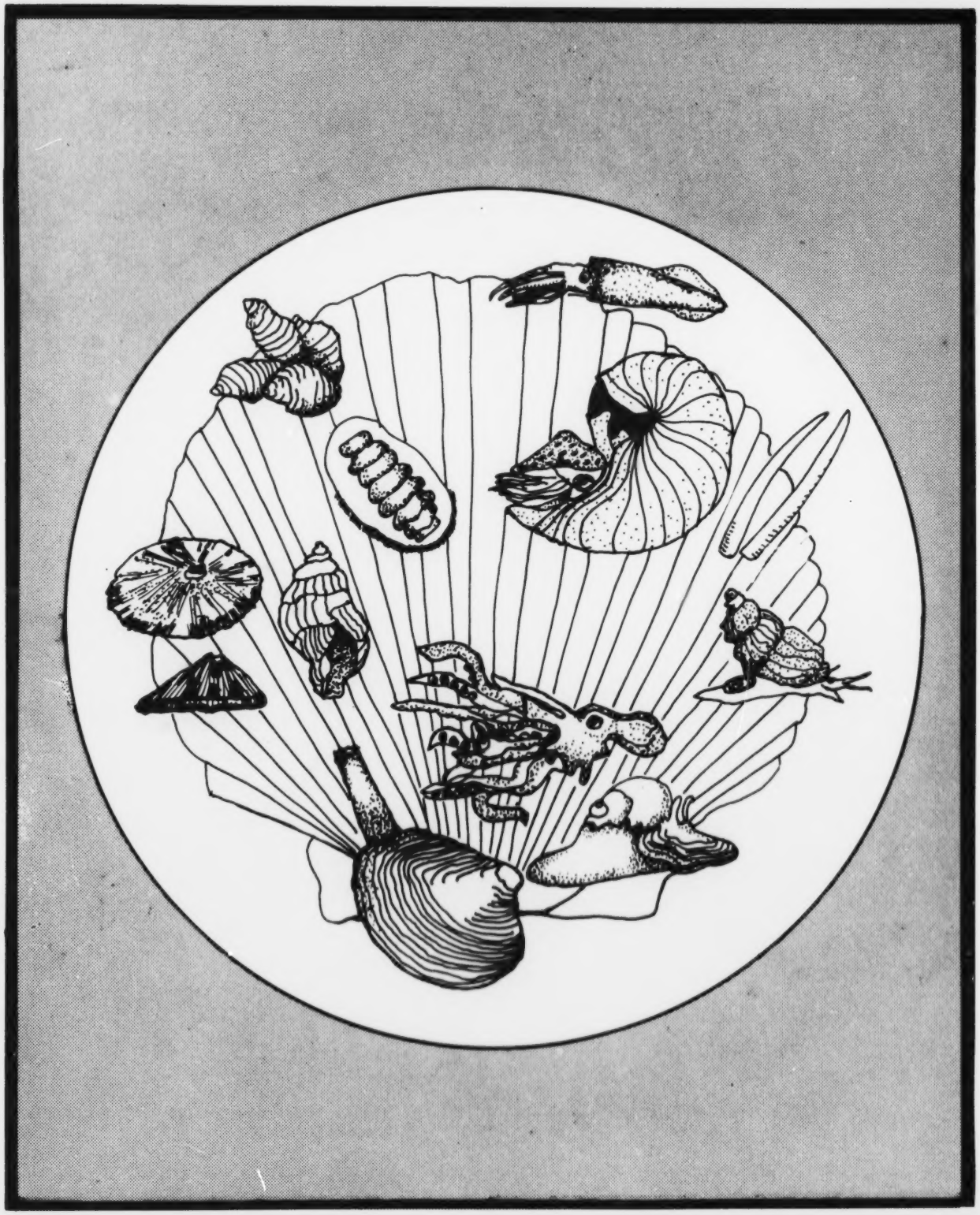
Activity 3: Shell Coat of Arms..... 7

Worksheet:
Coat of Arms 1C

Objectives:

To help students:

- Classify mollusks by major categories (Activity 1).
- List common mollusk characteristics (Activity 1).
- Make a print of a shell (Activity 2).
- Use their lucky shell as a basis of a coat of arms (Activity 3).



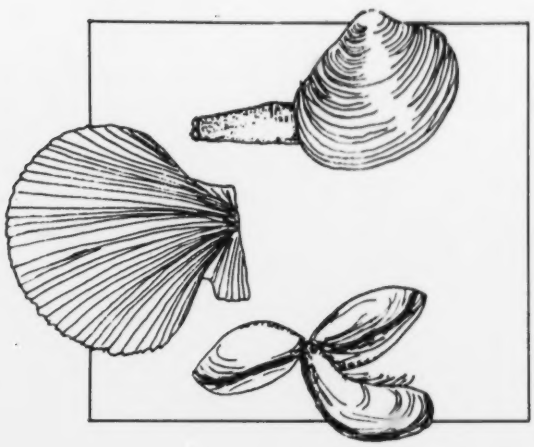
Unit One: Introduction to Mollusks. Categories: bivalves, univalves, cephalapods, chiton. Mollusks in history and culture: scallop, nautilus dentalium.

A mollusk has a soft body, usually with a prominent muscular foot used for locomotion.

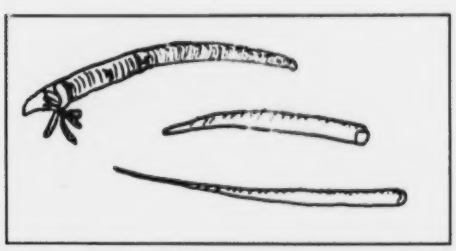
The mollusk body is in most cases protected by a limy shell produced by the mollusk itself. In a few cases, the shell is internal, or small, or lacking--as with nudibranchs (sea slugs). However, these are not the ones you will have in your "shell" collections.

Phylum Molluska includes these classes:

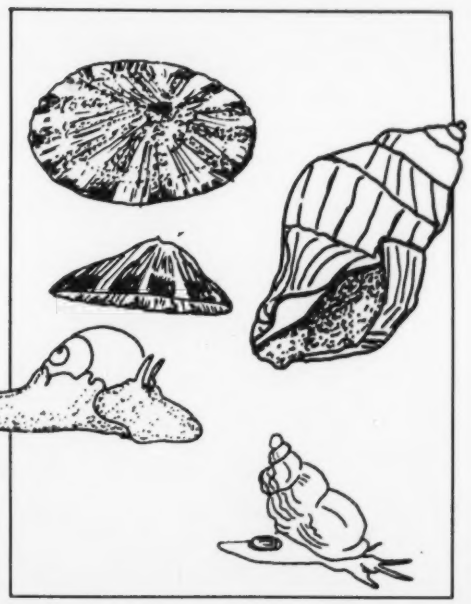
Bivalvia - bivalve shells such as clams, mussels and scallops.



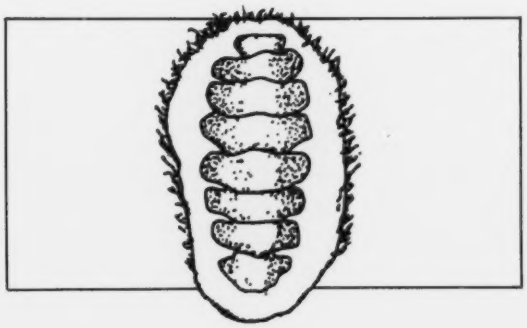
Scaphopoda - tooth shells such as tusk shells, Dentalium.



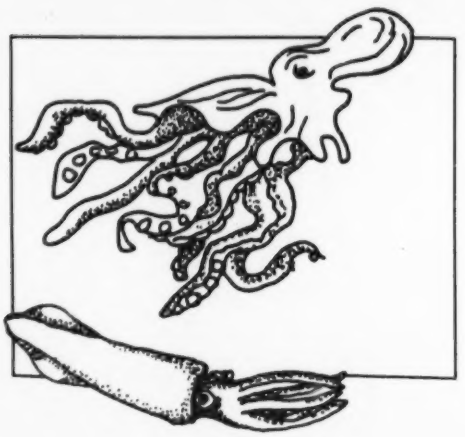
Gastropoda - univalves with conical or spiral shells and a distinct head with tentacles--such as snails and limpets.



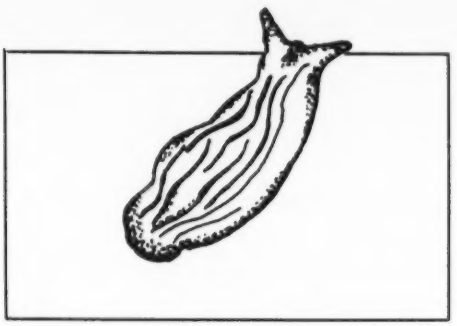
Polyplacophora - animals with a shell of eight plates or valves, such as chitons.



Cephalopoda - animals with a head and long arms, and bearing suction discs, such as octopus and squid.

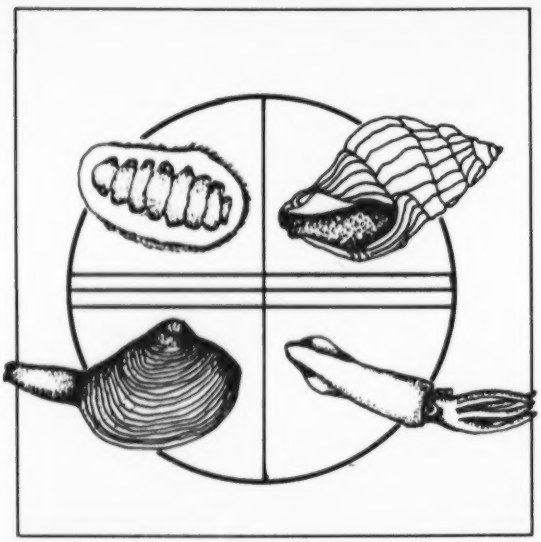


Aplacophora - animals without a shell; worm-like marine organisms.



We will be considering the bivalves and univalves (Gastropoda), chitons, and Cephalopoda.

Activity 1
Introduction to Mollusks



Materials:

- a variety of shells
- photographs or illustrations of different mollusks
- worksheets:
  ...Mollusks (1A)
  ...Mollusk Groups (1B)

Vocabulary:

- mollusk
- foot
- shell
- locomotion

Procedure:

1. Pass out shells and begin by asking students what they are, if they are living or dead, where they come from, if they've seen them before. Ask students what they know about shells.

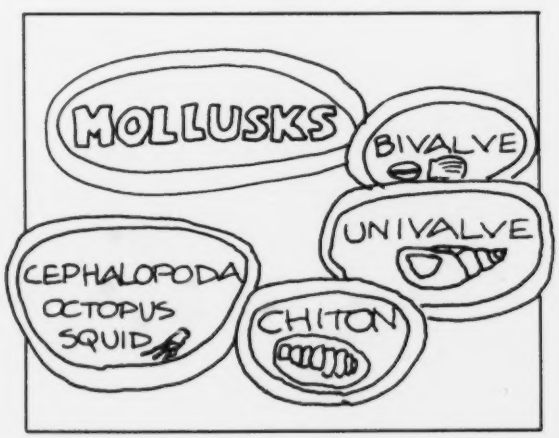
2. Using pictures and worksheets, discuss the idea that some marine animals live inside very hard shells and travel about--or dig--with a large muscular foot. These animals come in a wide range of shapes and sizes, but are all called mollusks.

3. Note that some mollusks, such as octopuses, squids and nudibranchs (sea slugs) can fool observers by not having a hard shell covering.

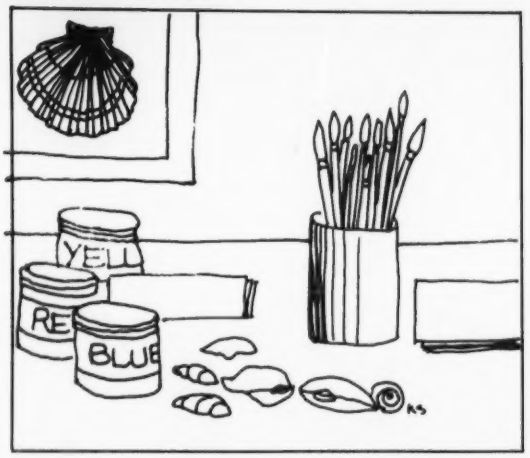
4. Ask students how the shells are similar, and then different.

5. Make a list on the board of what students would like to find out about shells.

6. Write bivalve, univalve, chiton and Cephlapoda on the board, and group the pictures and shells by these categories. Use the mollusk worksheets, plus photographs and examples, to introduce students to mollusks and the mollusk groups.



Activity 2
Shell Prints



Materials:

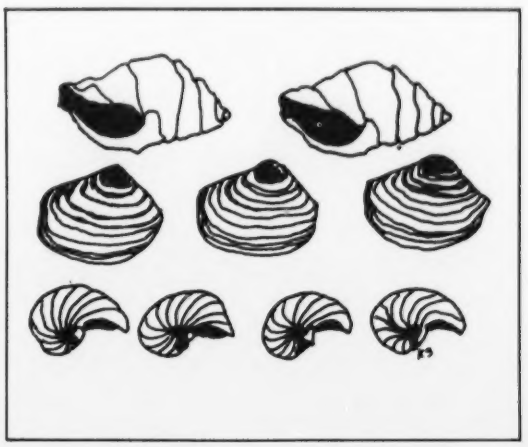
- a variety of shells
- newsprint
- paintbrushes
- paints or block print ink diluted with water
- newspaper

Procedure:

1. Cover the work area with newspaper.

2. Have students choose several interesting shells they wish to print, and then have them plan a print design.

3. Using a paintbrush, demonstrate printmaking by covering a shell evenly with paint. Make sure the paint is not too thin. Place the shell on the newspaper and have students gently press the newsprint down on the shell, rubbing back and forth gently until the impression of the shell is on the paper. Repeat these steps with other shells, then let the finished print dry.

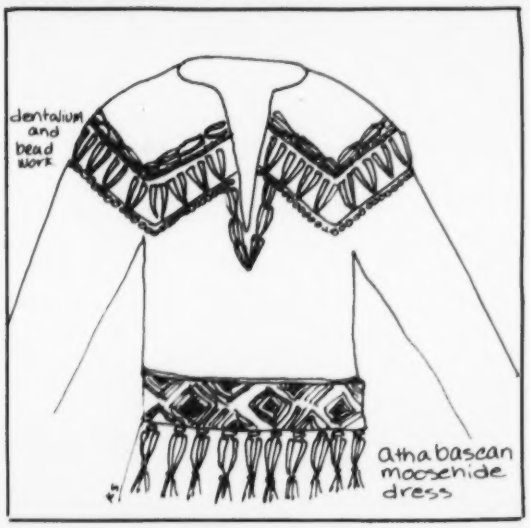


Variations:

- Cut out the prints and mount them on contrasting paper.

- Combine shell printing with painting, or include shell prints as part of a collage.

Activity 3
Shell Coat of Arms



Background:

Romantic traditions are associated with shells through history, art and legend. Shells were used as good luck charms, as mediums of trade, and as money. Cowrie shells were used as money in China from 2000-600 BC, until they were replaced by metal coins shaped like small cowrie shells. Cowrie shells also were found in graves in Egypt, Germany and Lithuania. Indians of the American Northwest used the tusk shell, Dentalium, as money in pre-Russian periods; while on the East Coast, wampum money consisted of beads made from the hard-shelled clam. The Athabascans of Alaska's Interior used Dentalium necklaces as mediums of trade. Tlingits of Southeast Alaska traded ornamental shells with other Native groups and early Russian and American explorers. Have you or any of your students ever traded shells for other items or used them as good luck charms?

Shells have also been used as decoration. Peruvian Indians used symbols of cockle, scallop and oyster shells in their art. In Mediterranean areas, a popular picture on vases and other pottery depicted Venus, the goddess of love and beauty, being born from a scallop shell. The stained glass windows of medieval churches also depict scallop shells. Scallops, associated with pilgrimages to St. James' grave were worn by crusaders, and appear on coats of arms of families whose ancestors fought in the holy wars. Some coats of arms were decorated with whelks, although more popular patterns included unicorns, lions, swords and castles.

Materials:

- crayons
- paper
- worksheet:
  ...Coat of Arms (1C)

Vocabulary:

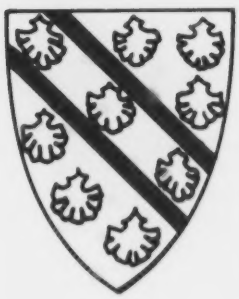
- luck
- coat of arms
- shield
- scallop

Procedure:

1. Have students draw a picture of a shell that they would like as a good luck charm. Discuss the use of shells in legends and history.

2. Explain that a coat of arms was a shield used to identify a family. Each coat of arms had pictures or symbols on it that told a story about the family. Point out the coat of arms on the worksheet and identify the shell as a scallop.

3. Have students design their own coats of arms using their lucky shells and other pictures.



Unit Two
The Bivalves

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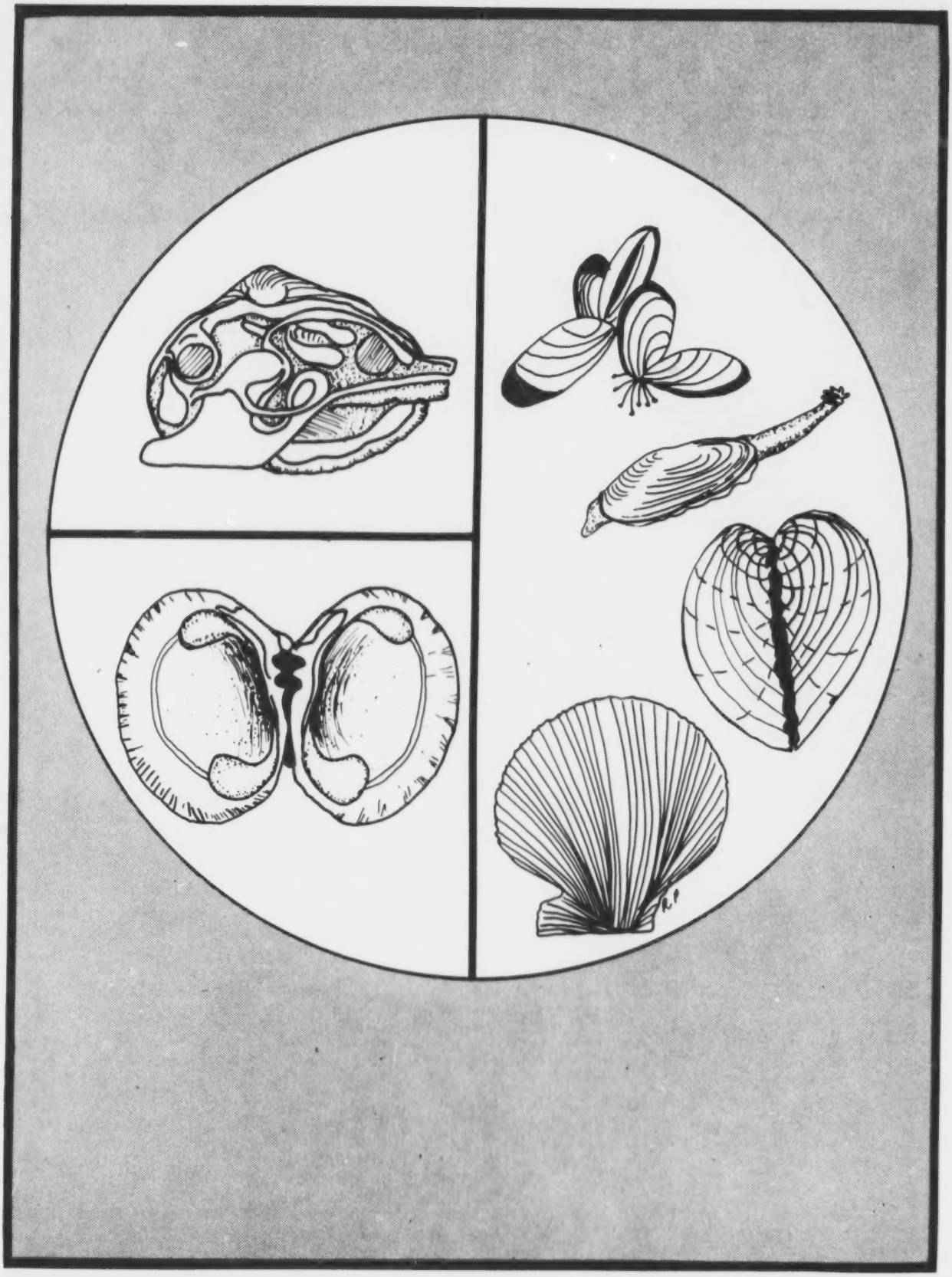
Objectives:

To help students:

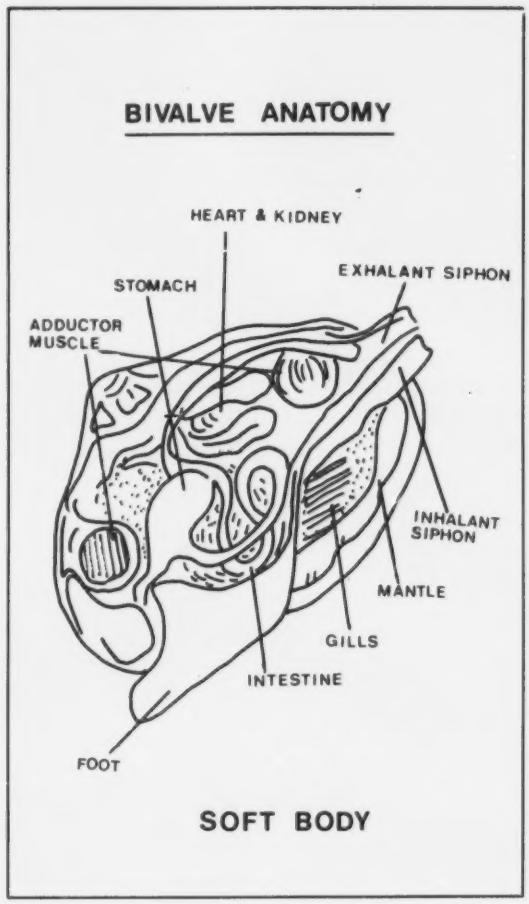
- Report that bivalve means "two shells" (Activity 1).
- Make a stuffed bivalve to learn local shell species and forms (Activity 2).
- Recognize local bivalves (Activities 1, 2, 3, 5, 6, 7).
- Label the external and internal features of bivalves (Activities 1, 2, 3, 5, 6, 7).
- Identify bivalve feeding habits (Activities 1, 5, 7).
- Make clam chowder (Activity 4).
- Learn that eating bivalves can cause paralytic shellfish poisoining (Activity 4).
- Count growth rings to age bivalve shells (Activity 6)

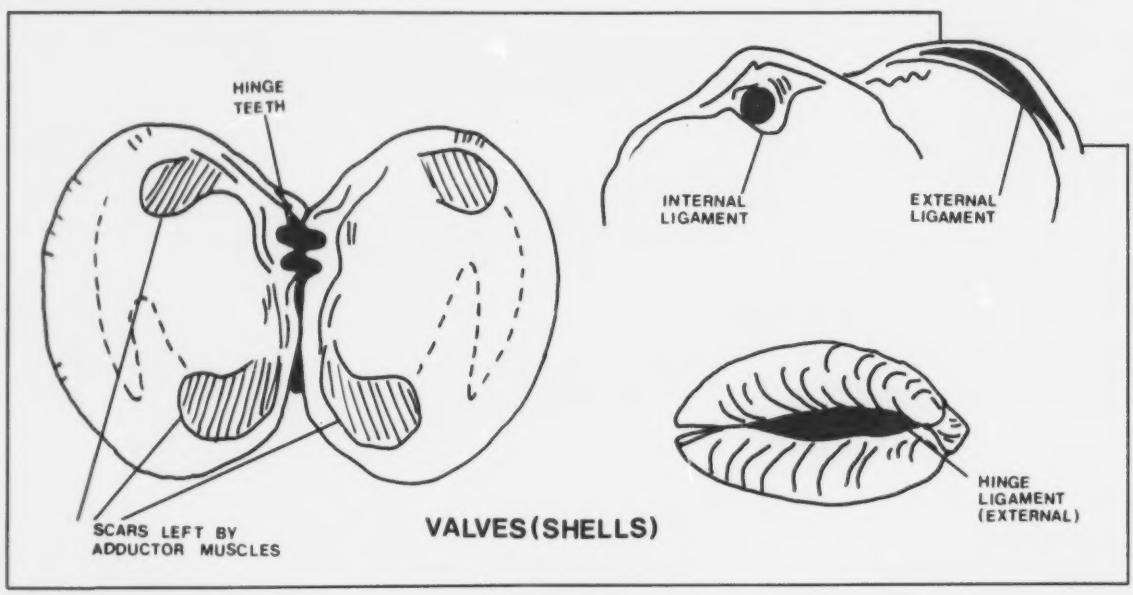


Unit Two: The Bivalves. Bivalve internal anatomy (upper left) and external anatomy (lower left). Bivalve groups: (clockwise from top right) mussel, clam, cockle, scallop.

Most bivalves have a soft body protected by two valves (shells). Clams and some other bivalves have:

- a stomach
- mouth
- heart, kidneys and liver
- intestines
- gills (for breathing)
- siphons (two: one called an incurrent siphon, for bringing in new water, air and food; the other called excurrent siphon, for sending out "used" water and wastes.)
- a mantle (a membranous flap that covers the mollusk's soft parts and secretes the material that forms the shell)
- a foot (for digging or moving through sand and mud)
- two powerful "adductor" muscles (that help hold and move the valves, and leave the scars visible on empty shells)
- hinge teeth and hinge ligaments, which help to hold the two valves of the bivalve shell together
- but NO head.





Most bivalves live quietly, often either attached to the sea floor or burrowed into it. Clams are always buried anterior (head) end down. Because of this predominantly stationary existence, bivalves need no head or well-developed sense organs to aid them in hunting food. Instead, they rely on circulating sea water to supply them with both oxygen and food. Using an incurrent siphon, they move sea water into their bodies where a "gill" exchanges gasses and collects the tiny food particles on which the bivalve feeds. The water exits through an excurrent siphon.

Bivalves usually are either male or female. When conditions are right for spawning, the bivalve releases either eggs or sperm in a stream. Egg and sperm unite in open water, and the developing larvae are free-swimming for a time. Within a few weeks, however, they settle to the sea floor and change into their adult forms.

Few age studies have been done on Alaska's bivalves, but we do know that cockles live as long as 17 years, razor clams 19 years, the giant scallop 18 years, butter clams 24 years and red-neck clams to 32 years. Growth rings on a bivalve shell are similar to the growth rings on the cross-section of a tree trunk. Each "wide-open space" represents summer periods of abundant food and good growth, while the closely spaced rings (called "annuli") indicate winter periods of less food and slower growth.

Freshwater Bivalves: The two kinds of bivalves that students are likely to discover in Alaska ponds are in the families Sphaeridae or Unionidae.

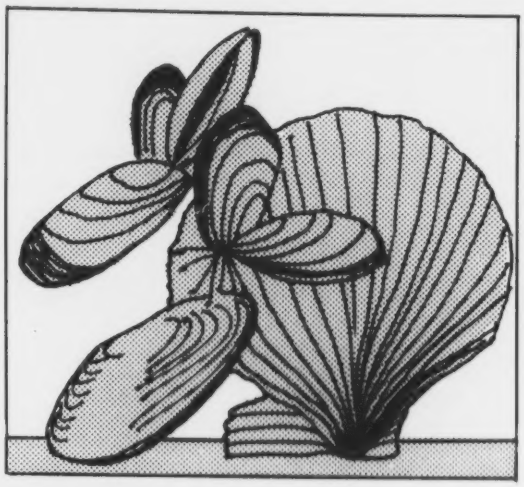
Sphaeridae, small bivalves ranging from 2 to 25 mm, are often called fingernail clams. The shells are fragile and faintly polished. Children should find it easy to locate Sphaerids on pond bottoms.

Unionidae are the larger clams or mussels that students might dig from pond mud. Commonly called pearly mussels, or naiads, they take up in size where the Sphaerids leave off. They range from 25 mm to 250 mm. The shell varies in shape, is more rugged than its smaller cousin, and is usually dull in color. The clam Anodonta beringiana is the large freshwater clam found throughout most of Alaska. Normally found in the still parts of rivers, streams and lakes, they situate themselves with up to one-third of the shell exposed. They are quite active and often can be located by following their furrows on the bottom or by discovering the inch-long slit they make in the mud to allow water to their siptome.

Anodonta

Their shell also can be found around muskrat pushups, where the muskrats have eaten them. Human consumption of pond clams is slight, but the little mollusks could provide a good source of protein.

Activity 1
Introduction to Bivalves



Materials:

- bivalve shells
- pictures of beaches
- worksheets:
  - ...Bivalve Vocabulary (2A)
  - ...Bivalve Shells (2B)
  - ...Bivalves Have No Head (2C)
  - ...Bivalve Parts (2D)

Vocabulary:

- bivalve
- hinge teeth

Procedure:

1. Ask students which shells are bivalves. (The ones with two shells)

2. Explain that valve is another word for shell. Ask what students think the "bi" means. (Two)

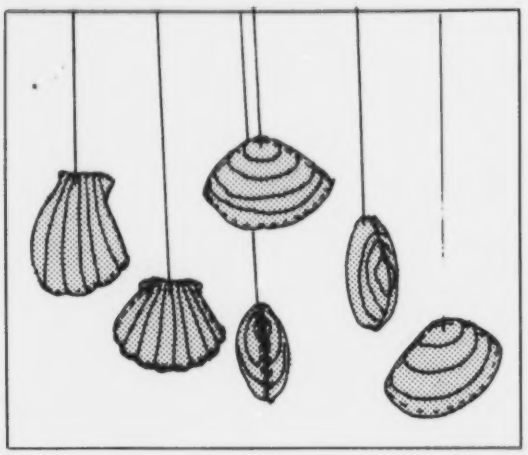
3. Encourage students to think of as many words as they can that have the prefix bi-. Include such words as:

biannual	bicycle
biweekly	bienrial
bilingual	bimonthly
bicameral	binoculars
bicentennial	bilateral
bipolar	

4. Discuss the word meanings. Where is the "two" in each?

5. Discuss bivalve internal and external parts.

Activity 2
Making Stuffed Bivalves

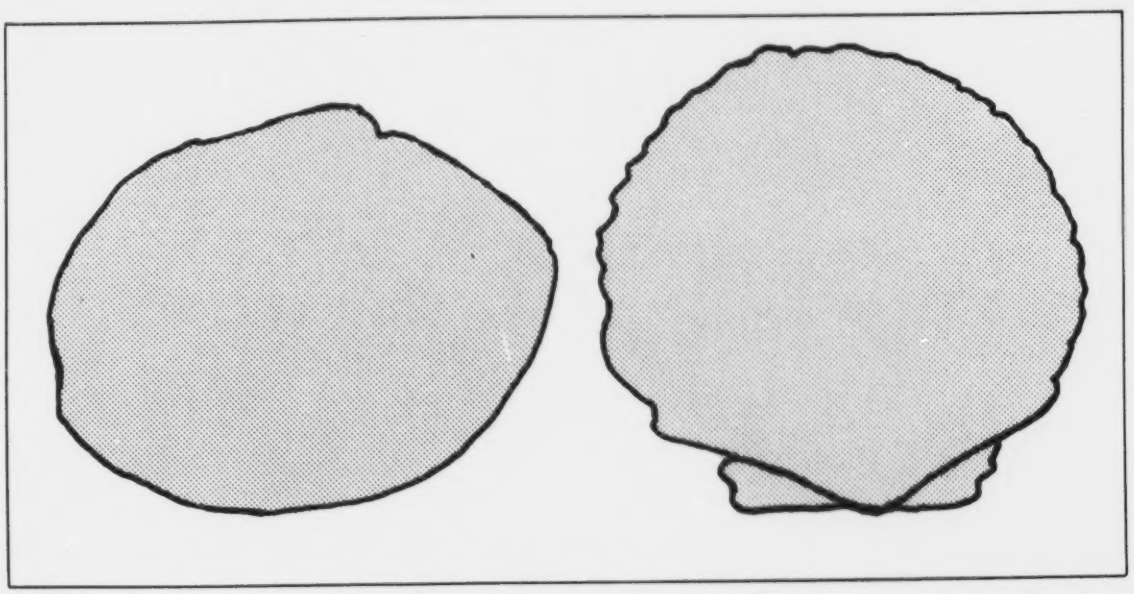


Materials:

- construction or butcher paper
- staples
- scissors
- cardboard
- newspapers

Procedure:

1. Make cardboard patterns for different bivalves such as scallops, clams and mussels.
2. Have children trace two copies of one pattern of their choice.
3. Each child can then cut out his or her pattern and either staple it almost all the way around the outside, or punch holes around the outside and lace the halves together almost all the way around.
4. The patterns can then be colored or painted to look like shells.
5. Crumple newspaper or paper scraps to stuff inside the shells. Staple shut the opening.
6. Label the shells by name. Hang them from the ceiling to make your room an undersea world.

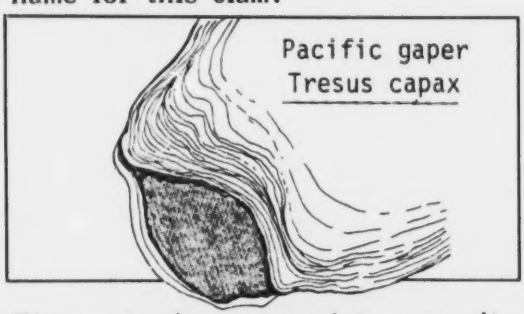


Activity 3
Introduction to Clams

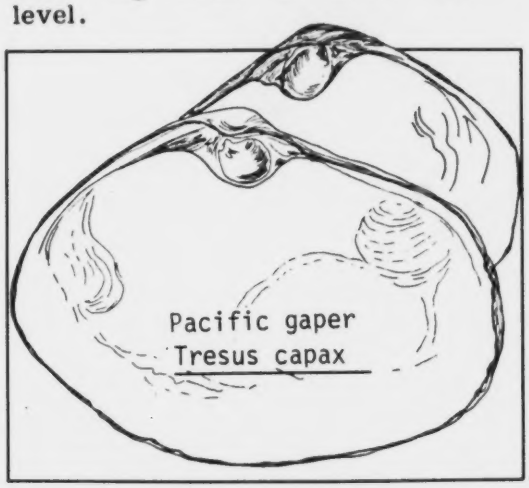
Background:

Numerous clam species are represented on Alaska beaches. Among the more common are:

Gaper, horse clam or Pacific gaper (Tresus capax) found from Northern California to Aleutian Islands, reaching a length of 201 mm and weighing up to 4½ pounds. Not all books will have the same Latin name for this clam.



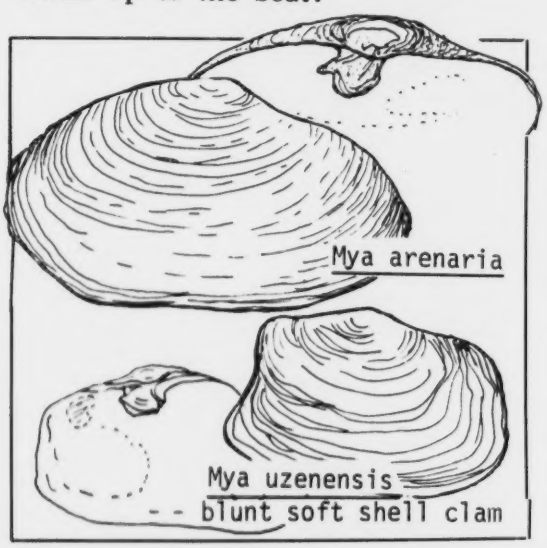
The gaper is so-named because its shell gapes wider at the end where it grows over the clam's large siphons (often called the clam's "neck"). A gaper clam may have a pair of immature pea crabs or an adult female pea crab living in its mantle cavity. Because they live deep in the sand, you probably will see only the old, surf-worn shells of the gaper clam. If unburied, these slow-moving clams will take four months to re-bury themselves just below ground level. It is doubtful that they can ever dig back to their normal level.



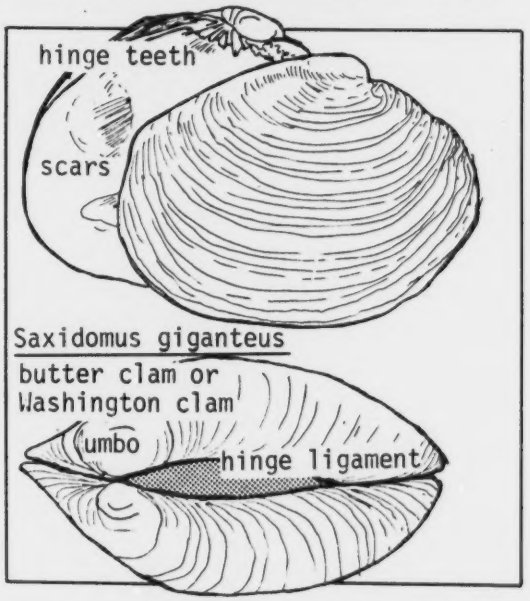
The blunt soft-shell clam, northern softshell clam (Mya uzenensis), or truncated mya--length to 86 mm--is quite common on beaches from the Arctic to Northern California. The blunt soft-shell has valves and siphons covered with a paper-like skin, or periostracum. The long siphons look like a neck, but really are at the clam's posterior end.

The blunt soft-shell clam's body is too big for its shell, so the two valves have a wide gap and never do really fit together. The two valves are unequal--one valve is always slightly longer than the other. When you see the shells on the beach, they look a little like tiny "geoducks." (Geoduck--pronounced "gooey-duck"--is the Chinook word for Panope generosa, a very large, edible, burrowing clam also found on southeastern Alaska's intertidal beaches.)

Soft-shell clams (Mya arenaria) live in mixtures of sand and mud or gravel and mud where there may be a freshwater stream entering salt water. This clam reveals its presence by squirting water when alarmed by withdrawing its neck suddenly into the mud or sand. Such clams are found from California north to the Arctic and reach 111 mm in length. Mya arenaria is the "steamer" of the East Coast, where it is harvested in Chesapeake Bay from boats fitted with escalators that dig in the mud down to 40 feet below the water surface and then carry the shells up to the boat.

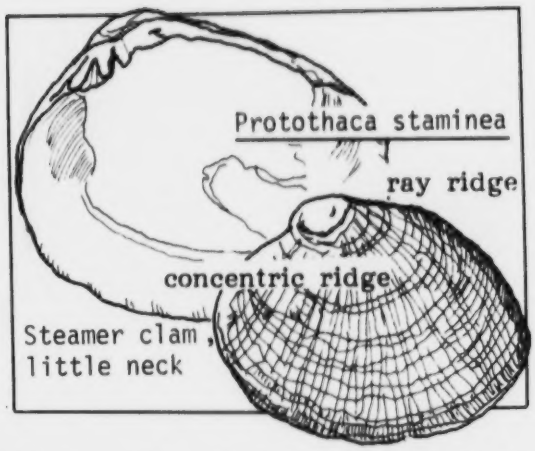


The butter clam, hardshell clam, Washington clam, or smooth Washington clam (Saxidomus giganteus) ranges from the Aleutians to Northern California and reaches 131 mm in length. Since its common names are used for a variety of other clams, it might be a good idea for the children to call this clam by its scientific name, Saxidomus (which means a rock house) giganteus (large). Saxidomus has a very heavy external hinge ligament, leather-like and rather rounded, which becomes brittle when old and dry. It is one of the larger and more common shells to be seen--often old and weathered--on Alaska beaches. The shells, being heavy, survive the wearing action of rocks and tide better than do the more fragile ones. With matching valves, Saxidomus has good hinge teeth to fit together. The old shells are quite chalky, however, so the teeth might be worn off. As adults they are slow burrowers, almost unable to move.



The steamer clam or little neck [Protothaca staminea (Paphia staminea in older texts)] is fairly abundant in Japan, as well as from the Aleutians to California. It is said to take about ten years to reach full size. You will find "adult" animals as small as 20 mm, though they may reach 64 mm.

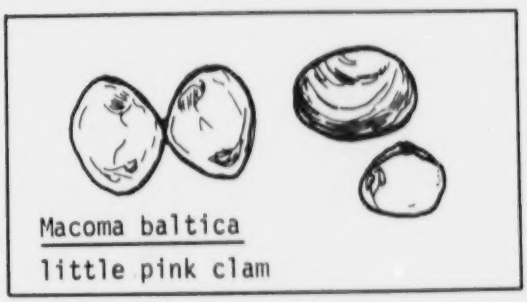
Young little neck clams sometimes have zigzag markings. The siphons (necks) are very short, so little necks are never very deep in the sand. The valves are thick and strong. The hinge ligament is external, and the hinge teeth are distinct, excellent for showing how hinge teeth interlock.



Little pink clams or navel clams (Macoma baltica) are found in the Atlantic to the Pacific from the Arctic to California. They reach a length of only 45 mm.

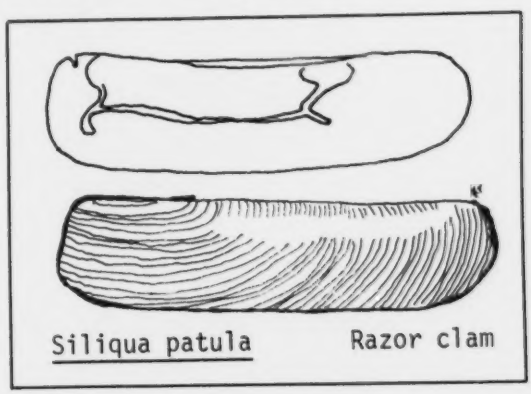
These are the lovely little pink shells so common to Alaska beaches. Farther south, they are sun-bleached to white, but in Alaska they usually are rose-pink, sometimes yellow or white. They do tend to fade when old and dry. Rubbing them lightly with a bit of baby oil or mineral oil will help keep the color bright, without making them unsuitable for a "scientific" collection (as laquer or plastic finish would).

Because the little pink clam is not strong enough to dig very deeply into the mud or sand, the live ones are quite near the surface. Shore birds feed heavily on this tiny clam.



Razor clams (Siliqua patula) range from California to the Aleutians, with this species growing to 173 mm. Another species, Siliqua alta, ranges from Cook Inlet to the Arctic, growing to 133 mm. Razor clams are excellent eating. They are found on sand or sand/mud beaches. Cordova was formerly the razor clam capitol of the world, until its clam beds shifted upward above sea level during the 1964 earthquake.

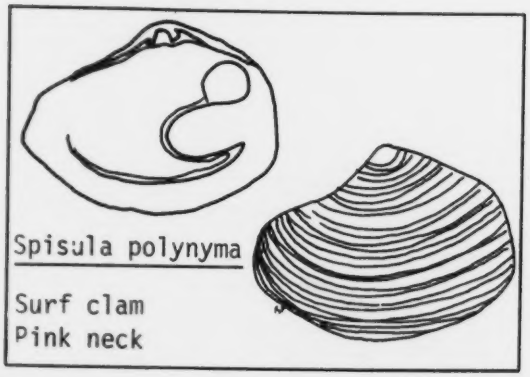
In Alaska, razor clams in Cordova and on the Kenai Peninsula grow the largest, to about 155 mm. Smaller razor clams are found along the coast of western Alaska. In Cordova a 100 mm razor clam is about nine years old. Razor clams up to 24 years old have been found in Alaska. The shells of all razor clams, large and small alike, are thin and slender. The outer covering or periostracum, is varnish-like and olive drab. On the inside of the shell is a distinct vertical or oblique rib.



To find "razors," clam diggers look for dimples in the sand, then dig quickly. A clam may be close to the surface, but it can rapidly retreat deeper and deeper, making digging a challenge. When surprised, it starts moving down at a rate of approximately one inch per second.

Surf clams or pink necks (Spisula polynyma) grow to 140 mm. Their shells are chalky white with a yellow-brown or gray outer covering, or periostracum.

These clams can be abundant on sandy beaches near low tide lines from the Arctic to Puget Sound. Clam diggers sometimes call them pink necks because of the color of the clam siphon.



Spisula polynyma

Surf clam
Pink neck

The northwest shipworm, or Pacific shipworm (Bankia setacea), is called shipworm because of its long, worm-like body; but it is really a clam! It is the most common wood borer found from the eastern Bering Sea to Southern California. Bankia was named "shipworm" back in the days when big ships were built of wood. When young, the shipworm settles on wood, such as a submerged log or wooden boat hull, and starts boring a hole with its two small shells (valves). The rest of its life it keeps working at its burrow, which gets larger as the clam gets larger, and longer and more worm-like. The animal may grow to be a meter long. The biggest shell of this mollusk is only 10 mm long. Bankia lines its burrow with a shell-like lining as it goes. Shipworms, though a menace to wooden vessels and piers, serves an important function by breaking down logs and debris washed into the ocean and thus preventing huge log jams along our beaches.

This shipworm's food is plankton brought in by the water, though it may get some nutrition from the wood it eats as it cuts its burrow.

Look at an old log on the beach. You probably will find old tunnels made by shipworms. Some will still have the shell-like lining. Sometimes other small clams such as saxicave will use the old burrows as a "home."

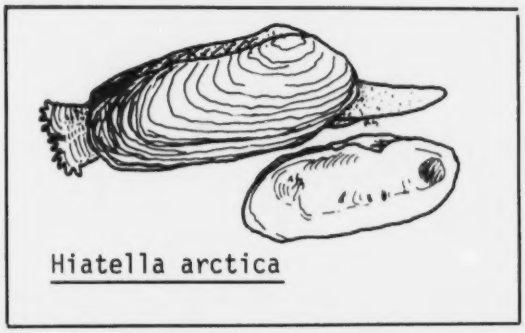
Alaska has other borers that grind holes or tunnels in rock, but we are not apt to see their burrows.

Bankia setacea

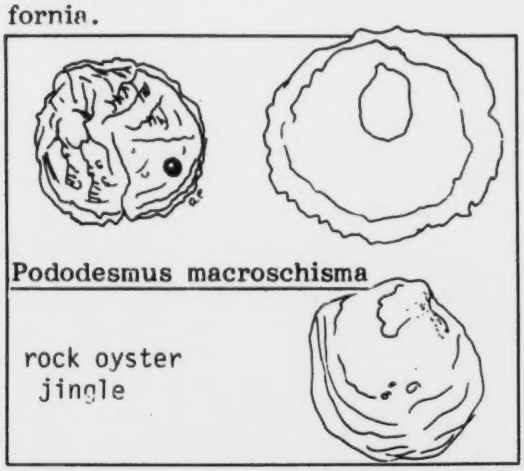
Pacific shipworm

The arctic saxicave (Hiatella artica) reaches only 49 mm in length and is more or less oblong. Its shape is often twisted or gnarled by where it lives. It prefers nesting in kelp holdfasts and rock crevices from Southern California to the Arctic and also in Japan and the Atlantic. A very similar species, H. pholadis, lives in clay or soft stone.

Hiatella are common on Alaska beaches. They will survive in the classroom for short periods of observation. (Be sure to put some sand or mud in the pan along with the salt water.)


Hiatella arctica

The jingle or rock oyster (Pododesmus macroschisma) is not an oyster at all--but it does fasten itself to a rocky surface and has a shell covering almost as rough and uneven as an oyster's. No true oysters inhabit Alaska waters except for a few in the state's extreme south near Ketchikan and some Pacific oysters from Japan planted in Southeast Alaska, Prince William Sound and Cook Inlet. Jingles range from the Chukchi Sea to Southern California.


Pododesmus macroschisma

rock oyster
jingle

The jingle grows to reach 92 mm in diameter. The inside of a jingle's shell is sea green. The flesh of the living animal is bright orange!

The upper valve of the jingle's shell is solid, but its lower valve has a hole through which the soft living animal puts a hard thread (byssus) that it uses to attach to a rock or other hard object.

The name "jingle" derives from the sound the loose shells make on the beaches as the waves move them around. The shells are so thin they may be translucent, and often will jingle if strung together.

Materials:

- clam shells
- worksheet:
  ...Clams (2E)

Vocabulary:

- hinge teeth
- muscle scar
- hinge ligaments
- growth rings

Procedure:

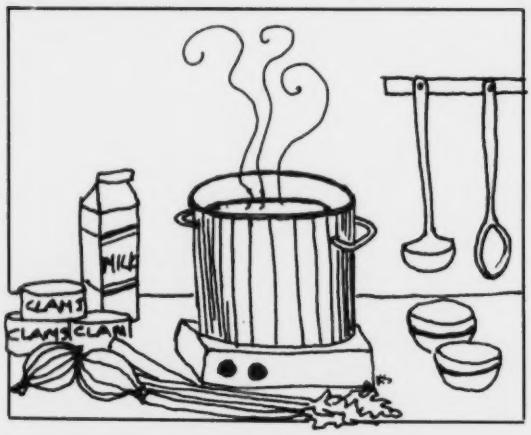
1. Give each child a clam shell. Discuss where the animal lives and how it uses the shell for protection and support.

2. Examine the shell for hinge teeth, muscle scars, hinge ligaments and growth rings. Ask the children to find the different features on their shells. Discuss what their uses are.

3. Have the children role-play a clam, with two children acting as shells and another as the animal inside.

4. Using the worksheet and clam specimens, identify the various kinds of local clams and discuss their similarities and differences.

Activity 4
Clam Chowder



Background:

Clams have been an important source of food in Alaska since humans first arrived. Piles of shells, which are refuse heaps called "middens," have been discovered covering areas up to 12 acres, and to depths of up to 17 feet. These middens mark the sites of ancient coastal villages.

Many Alaskans are both concerned and confused about "PSP," which stands for "Paralytic Shellfish Poisoning." Evidence of PSP resulted in statewide closure of commercial clam harvests in 1954. More recently, the National Shellfish Sanitation Program has approved specific areas in Alaska for commercial harvest, but the threat remains.

The following discussion briefly snyopsizes what PSP is, what its effects are, and what actions to take if poisoning is suspected. Research is currently underway, and more answers soon may be available.

PSP is caused by one of a number of neurotoxins or poisons carried by all stages of small, planktonic organisms called dinoflagellates. Traditional association with a red tide is not an adequate indicator of PSP. The toxin carrying dinoflagellates may be present in a red tide, but also may occur in significant numbers without a red tide. Conversely, a red tide may occur that contains none of the guilty dinoflagellates. The dinoflagellate and its toxin are taken into a bivalve through the inhalant siphon and then filtered out of the water as food. The toxin is concentrated in the dark portion of the bivalve, which includes its siphon and stomach.

PSP does not harm the clam, but in humans--as its name suggests--it causes paralysis. The onset of paralysis can range from a few minutes to 10 hours. Symptoms include numbness in the mouth, tongue and lips, spreading to the face. The numbness will be followed by a prickly feeling in the fingers and toes, plus headaches, dizziness and nausea. Serious cases progress to loss of coordination of limbs and speech difficulties accompanied by pulse rate increases and muscular paralysis. Death occurs because the muscular paralysis causes cessation of breathing.

If poisoning is suspected, the victim should be rushed to a hospital or other source of artificial respiration. Vomiting should be induced and a laxative administered to get rid of any toxic material still in the stomach. Keep the victim calm, relaxed and lying flat. If breathing becomes difficult or ceases, give artificial respiration.

Materials

- big pot
- hot plate
- stirring spoon
- serving bowls/cups
- measuring spoons
- spoons
- cooking pot
- cutting knife
- potato peeler
- ladle

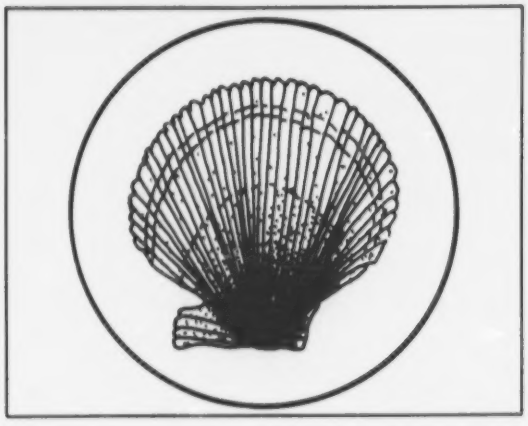
Ingredients: Quantities are estimates, which can be varied.

clams, 2-4 cans
bacon, 10 slices
potatoes, 6-8 large
celery, 6 stalks
onions, 2-3 medium
milk, 2 gallons
flour, 4 tablespoons
salt and pepper
crackers

Procedure:

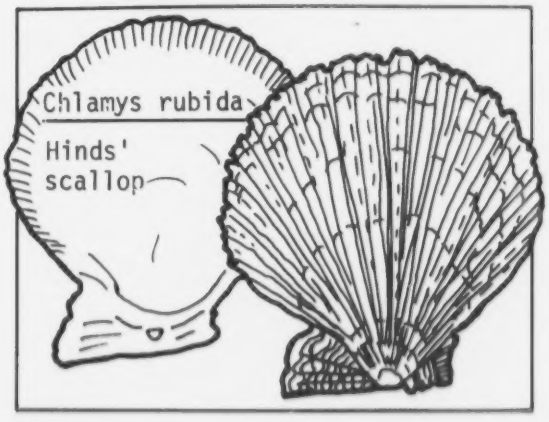
1. Make clam chowder. You may want to use canned clams, to avoid paralytic shellfish poisoning. This will provide a cooking experience and a "taste treat."
2. Have the children bring the equipment and ingredients and have them help in the planning.
3. Write the recipe on chart paper to provide a reading experience.
4. Cut bacon into chunks, cook slowly in pot.
5. Chop onion and celery, saute in "bacon drippings" till tender.
6. Cook potatoes (as little as possible without burning dry--remaining water and vitamins will go into chowder). Dice after cooking.
7. In big pot, add 4 tablespoons flour to onion and celery mixture.
8. Add clams, milk, leftover potato water, cooked potatoes diced, and salt and pepper to taste.
9. Serve in bowls with crackers.

Activity 5
Introducing Scallops



The beautiful scallops (Pecten and Chlamys) are the classic shell used in art and design (such as the Shell Oil Company insignia).

Alaska has 16 scallop species; but the shell you are most apt to find is the Hinds' scallop (Chlamys rubida), which ranges from the Arctic to California and reaches a maximum length of 67 mm, a rather small representative of the Chlamys genus. The Hinds' scallop's right valve usually is quite pink, and the left valve white or faintly pink. The color, however, is variable. Hinds' may be orange, yellow or rose.



Hinds' valves have wing-like "ears," one much wider than the other.

In the live animal, the "ruffly" mantle between the two valves has a row of tentacles. The edge of the mantle is bordered with tiny, shiny, blue-green eyes.

Scallops swim by clapping their shells together as a sort of "jet propulsion." The Chlamys attach themselves to the bottom with threads (byssus), similar to mussels, and only rarely move. They filter microscopic food from the water.

Pecten caurinus, called the "weathervane scallop" or "giant Pacific scallop," ranges from the southern Bering Sea to Northern California and has a maximum length of 210 mm. It is found in deep water only; but if you have a shell exhibit, this is a big, "showy" shell that someone will surely bring.

Materials:

- scallop shells
- slides or other illustrations showing scallops
- worksheet:
  ...A Scallop is a Bivalve (2F)

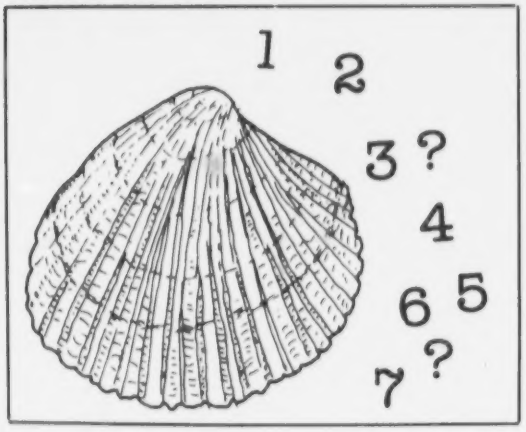
Procedure:

1. Examine the scallop shells. Discuss scallop shape, characteristic "ears," and behavior.

2. Imitate scallop movement by clapping hands together. Wiggling fingers can imitate tentacles and eyes.

3. Discuss and share the scallop worksheet as a class.

Activity 6
Age a Cockle



Background:

"Cockle," "heart cockle," and "basket cockle" all are names for Clinicardium nuttalii (most older books will use the name Cardium cordis).

Cockles can be found from Japan to the Chukchi Sea and to California, and may be as large as 173 mm in length.

There are six other cockles in Alaska, but C. nuttalii is the most common.

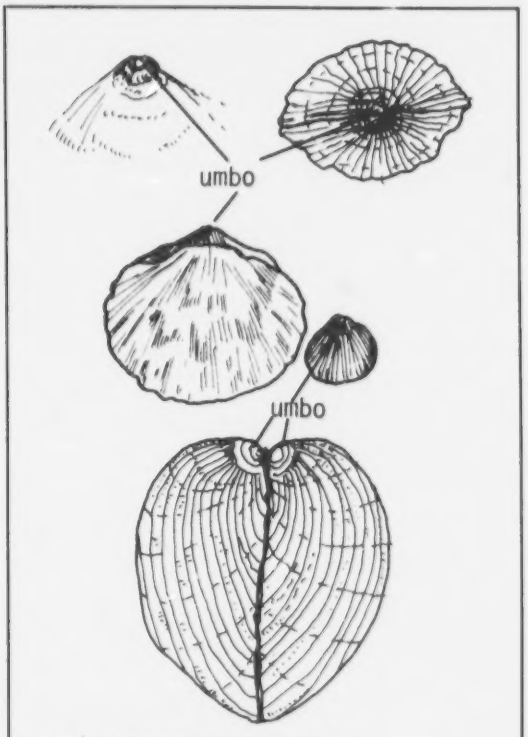
Cockles are members of the clam family, and have both "hinge teeth" and "hinge ligaments."

You will find cockle shells of all sizes (ages). The young specimens often are yellow, with brown mottling inside. The very tiny ones may have a blue umbo.

The umbo is the oldest part of the shell (valve). All shells have growth lines, but growth lines are most easily seen on cockles, on which each section looks like a complete shell.

If you look at the umbo, you will see the form of the tiny cockle where the shell began its growth.

If the shell is not too worn, the cockle is good for showing how hinge teeth fit together.



Clinicardium nuttalii
heart cockle

Materials:

- cockle samples
- pictures of cockles
- worksheets:
  ...Cockles (2G)
  ...Umbo (2H)

Vocabulary:

- hinge teeth
- hinge ligaments
- umbo
- growth lines

Procedure:

1. Pass out shells and worksheets.

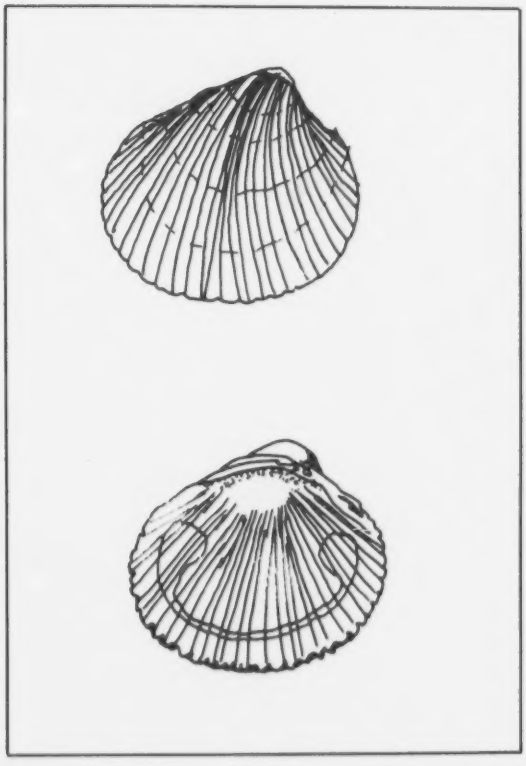
2. Examine the cockle and its shell with students.

3. Point out the umbo, growth ring ridges (just like the annual rings visible in tree cross-sections) and the shell's shape, texture and color.

4. Have students count the growth rings and age the cockle samples (or worksheet cockles).

5. Find out who has the oldest cockle, the youngest cockle.

6. Have equal groups of students add the ages of their cockles and see which group has the largest number.



Activity 7
The Life of a Mussel

Background:

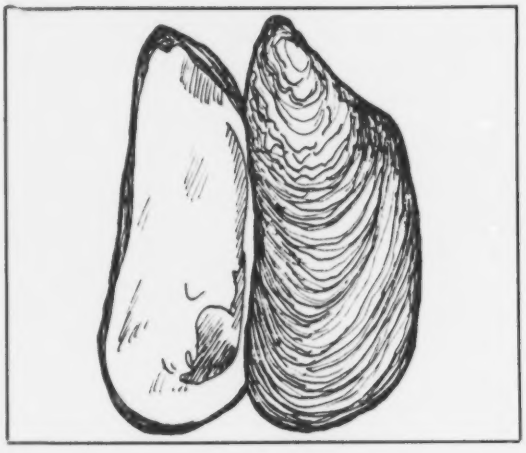
Blue mussels (Mytilus edulis) live on many Alaska beaches. They grow in a variety of sizes, reaching 99.5 mm. Old, empty shells may accumulate in windrows on the beach.

The valves (shells) of the blue mussel generally are bluish black. Immature shells often are a light, almost translucent, brown, though they may be black at any size or age.

Since the mussel does not use its foot for digging or travel, the foot is not large. The mussel has only one siphon.

Mussels anchor themselves to rocks or pilings (or wood, or cans, or even other shells!) with strong "guy wires"--or threads--called byssus.

Clams and mussels obtain their food by straining microscopic plants and animals (plankton) from sea water. For this reason, bivalves often are called "filter feeders."



The mussel, so common in most of Alaska, is a good animal to use to introduce students to habitat and feeding. Like most bivalves, the mussel filters its plankton food from the water it siphons. The place or zone on the beach where the mussel lives is its habitat. The mussels themselves provide a habitat for other organisms that live among the shells and byssal threads.

Materials:

- mussel shells (live or preserved specimen optional)
- pictures or illustrations of mussels
- worksheets:
  ...Mussel Food (2I)
  ...Who Am I? (2J)

Vocabulary:

- mussel
- muscle scar
- hinge
- byssal thread
- shell
- habitat

Procedure:

1. Give each child a mussel shell or picture. Review the term bivalve.

2. Ask the students to find the hinge and the muscle scars, and to describe the differences in the outer and inner layers of the shell. Use the Who Am I worksheet.

3. If some of the shells have a few byssus threads still attached to them, point these out and ask how they might be used and why they are important to the mussel.

4. Have students recall where they find mussels. Are they near the water's edge or far from it? In low or high tidal zones? Do mussels occur in bunches or singly?

5. Introduce the term "habitat" as the place where an animal lives. Write "habitat" on the board.

6. Ask what animals need to survive. Explain that each habitat must provide space for the organism to live, and food and water.

7. Use the food element of a habitat to introduce mussel and bivalve feeding habits. Review siphons and how bivalves pull water in and out, filtering or straining food from the water. Use the Mussel Food worksheet.

8. Review the idea of shellfish poisoning--what causes it, what it does, and so on. Emphasize the need for caution in eating mussels, because they absorb the toxin much more rapidly than do many other bivalves and thus can be especially poisonous.

Unit Three
Univalves

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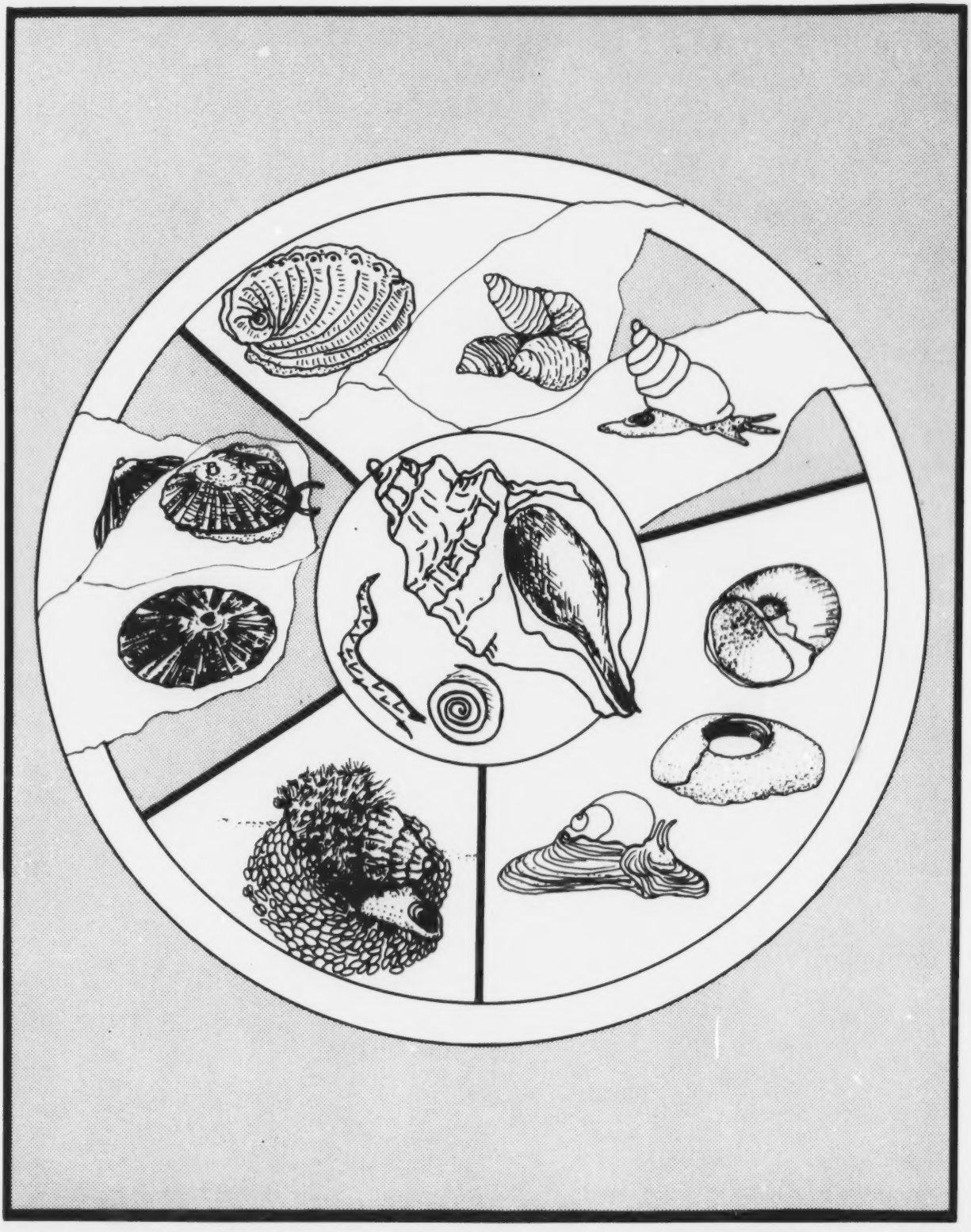
Abalone 3F

Objectives:

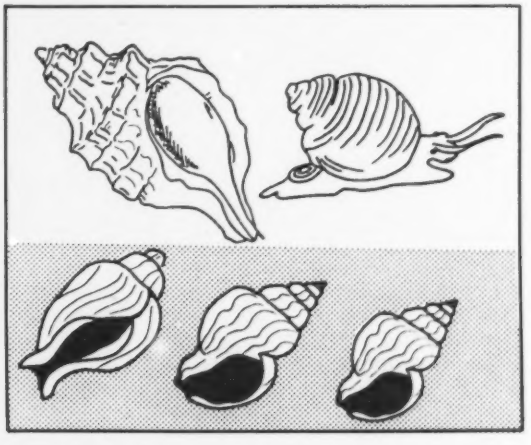
To help students:

- Define univalve as "one shell" (Activity 1).
- Identify the parts of a univalve (Activity 1).
- Compare univalves with each other and with other mollusks (Activities 1, 2).
- Recognize a number of local univalve species (Activities 2, 3, 4, 5, 7).
- Practice numbers and arithmetic using snails (Activity 6).
- Observe life habits of univalves (Activities 3, 5).



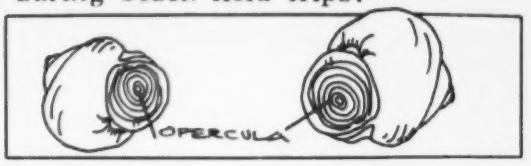
Unit Three: The Univalves. Univalve parts and vocabulary (center). Univalve groups (clockwise from left): limpet, abalone, periwinkle and welk, moon snail, hairy triton.

A univalve is a mollusk, such as a snail, with a one-piece shell. In this unit we'll be looking at the large class of univalves known as gastropods. The gastropods include such spiral-shelled univalves as the snail, whelk and periwinkle; and such cone- or dish-shelled univalves as the limpet and abalone. Good in-depth references on univalves include Seashells of North America, Marine Shells of the Pacific Coast and American Seashells (see bibliography).



"Gastropod" is Latin for "stomach-foot," the main part of the body being the foot with which the animal travels. Attached directly to the foot are the head, tentacles ("feelers") and eyes, as well as internal organs arranged to fit the contour of the shell. The foot is soft and vulnerable, even when retracted into the shell. As a result, most spiral-shelled gastropods have evolved a hinged piece of shell called the "operculum," which the animal uses as a door to close the entrance to the shell as it withdraws.

The shape of the operculum, of course, depends upon the shape of the opening to be closed. Some opercula are paper-thin and others are thick and horny-like shells. Several types have been used by native cultures as jewelry. Youngsters often find dozens of round, translucent, amber opercula during beach field trips.

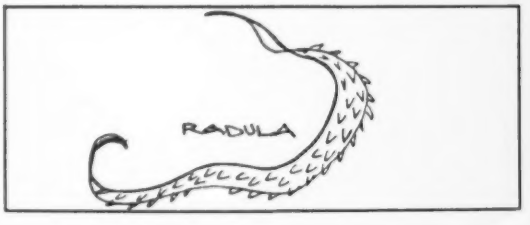


Gastropods such as the limpet and abalone don't need opercula; they just pull down tight against whatever they're on, and sometimes with incredible suction!

While gastropods are alive, their shells are covered with an outer skin called the "periostracum," which can be thin and laquer-like, velvety, or even hairy or bristly (as on the tritons).

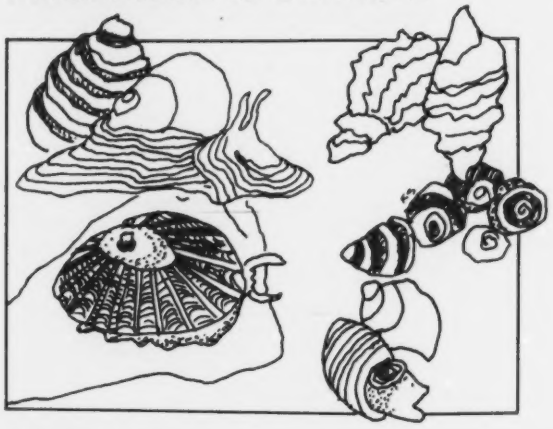
The radula is a long, file-like tongue in the mouth of most gastropods, used by some to drill holes through the shells of victims, and by others to scrape microscopic plant food from rocks and other surfaces.

Some gastropods also have siphons, with which they draw in water.



Univalves found in fresh water are the familiar snails. Generally, they are the same as saltwater univalves in structure and form. Some have operculums, others do not. Some breathe with a lung, some with gills. Students may find disc, or flat, spiral snails, or those with spires that twist to a point.

Activity 1
Introduction to Univalves



Materials:

- sample univalve shells
- pictures of univalves
- worksheet:
  ...Univalve Vocabulary (3A)

Procedure:

1. Hand out the shells. Ask students:

   - Why do you think the univalve inside is smooth? (to prevent injury to the soft-bodied animal inside)

   - Why do you think the univalve is rougher on the outside? (to provide protection from elements, weathering)

   - Do you think the animal that lives inside the univalve has bones? (no) Why? (the univalve shape makes bones inappropriate)

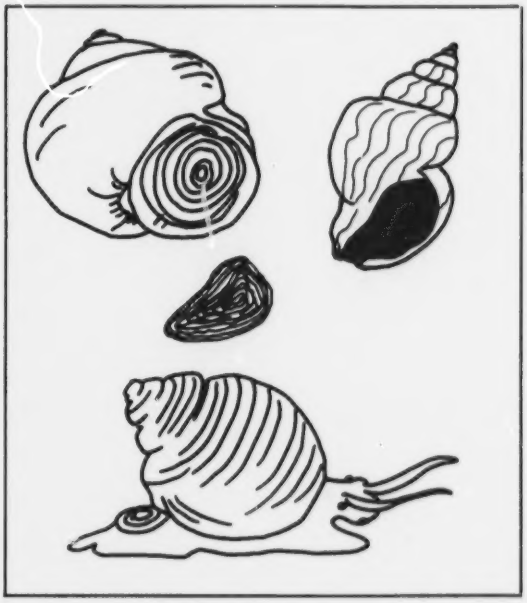
   - What is your favorite part of the univalve?

   - If you had a big univalve, what would you make out of it?

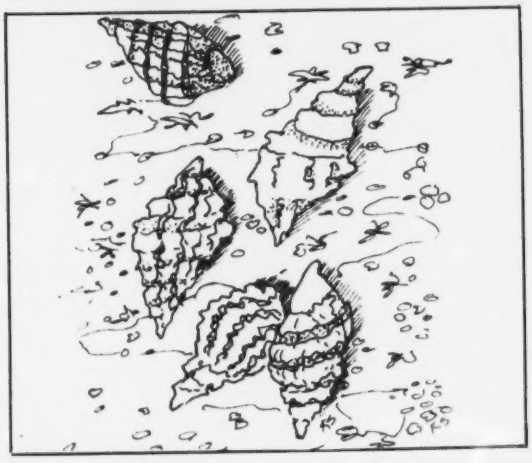
2. Early in the discussion, ask students to focus on the word "univalve." Having already learned about bivalves, they should be able to guess at the word's meaning. [A univalve is an animal with only one part (uni) to its shell (valve)]. Ask the class to think of other words with the prefix "uni." Discuss the word meanings. Some suggestions:

unicorn	unilingual
unicolor	unique
unicycle	united
uniform	universe

3. Use the worksheet to point out and label important shell parts. Explain that, internally, the univalve has many of the same structures found in a bivalve, but in the univalve, those organs are most often twisted into the spiral shell. Externally, the univalve has tentacles and eyes, both of which the bivalve lacks.



Activity 2
Individual Differences



Background:

The whelks are among Alaska's most decorative univalves.

Known scientifically as Nucella lamellosa, the whelks are extremely variant in size, shape and color. Some have flared shells, some frilled, some sculpted. As a result of the wide variety, whelks in Alaska are known by many names, including "frilled dog-winkle," "wrinkled thais," and "wrinkled purple" (purple referring to a dye made from the crushed shell, not the shell color).

Materials:

- a number of Nucella lamellosa (whelk) shells, of considerable variation
- worksheet:
  ...Whelk (3B)

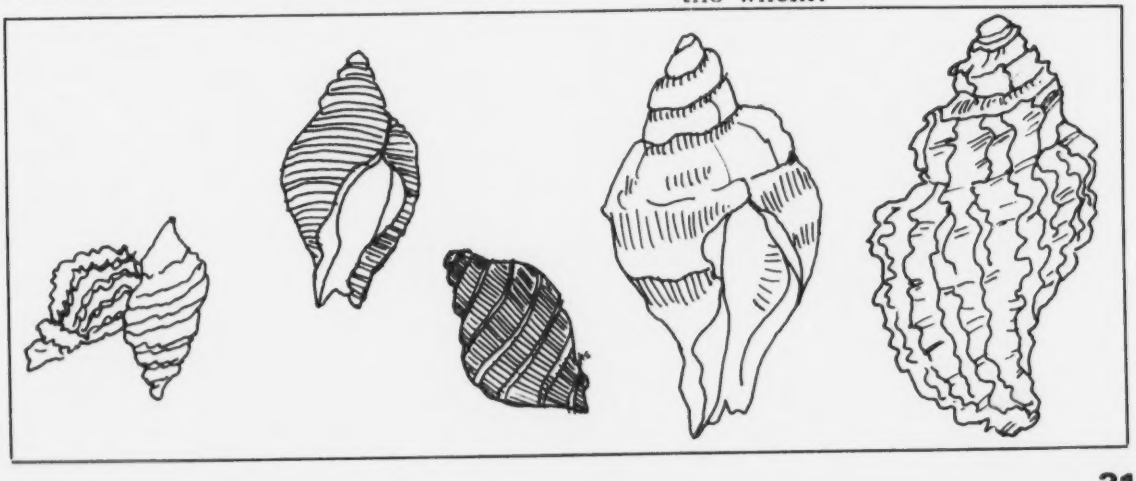
Procedure:

1. Pass out whelk shells to students seated in a circle.

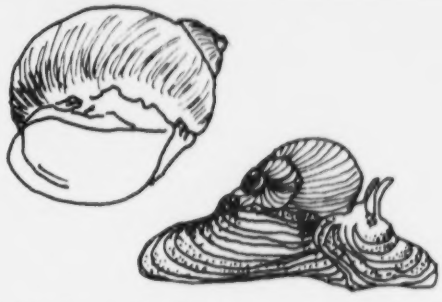
2. Point out that like people, whelks are individuals. Ask students to see how many different colors, shapes and patterns they can find. Can anyone find a color that no other shell has?

3. Ask students to get acquainted with their whelk "friends." Then have them close their eyes while you gather the whelks. Put them in the center of the circle and have the students, one-by-one, pick their whelk from among the rest. If the shells show great variety, the students can choose them by touch by passing them around the circle while blindfolded.

4. Use the worksheet to review the whelk.

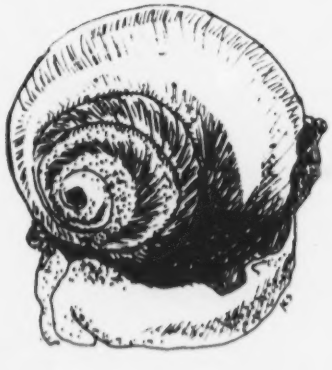


Activity 3
Moon Snail Attacks

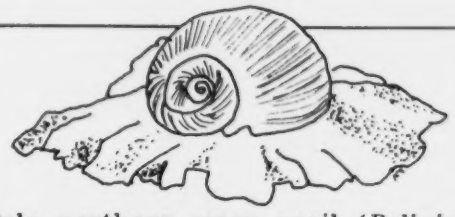


Polinices lewisii

The moon snail, or "arctic natica" (Natica clausa), usually is light brown, though surf-worn shells may be white. Moon snails often are used as homes by hermit crabs when the crabs outgrow the smaller periwinkle and margarite shells. The arctic natica and the pale northern (Polinices pallida) moon snails both grow shells about 1 1/2 inches long; but Lewis' moon snail (Polinices lewissii), found only in southern southeast Alaska, grows to five inches.



Lewis' moon snail (Polinices lewisii)

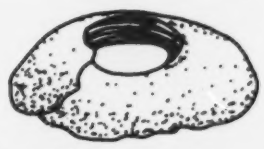


Pale northern moon snail (Polinices pallida)

The moon snail has an extremely large foot and mantle, which when spread out is much larger than the shell. Nonetheless, the moon snail is able to pull all this oversized body back inside the shell. Sometimes the perfectly round holes you see in clam shells are made by the radula of a moon snail. The moon snail is a carnivore (meat eater), feeding on clams and other creatures.

Arctic natica (Natica clausa)

The "sand collar" is the egg case of the moon snail. It is large, more or less in the shape of the snail's expanded body, and looks something like a "plumber's friend" (rubber suction cup). The eggs are held together by a gelatinous "glue," encrusted with sand or fine-crushed shell. The texture of the sand collar will vary with the different sands from beach to beach.



"Sand collar" or egg case

Materials:

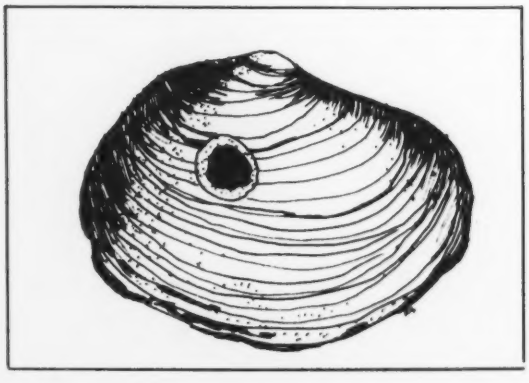
- open space
- moon snail shells
- mollusk shells with small holes in them
- worksheet:
  ...Moon Snail (3C)

Vocabulary:

- radula
- byssal threads
- predator

Procedure:

1. Show students mollusk shells with holes in them. If you have none, ask students if they have ever seen shells with holes.



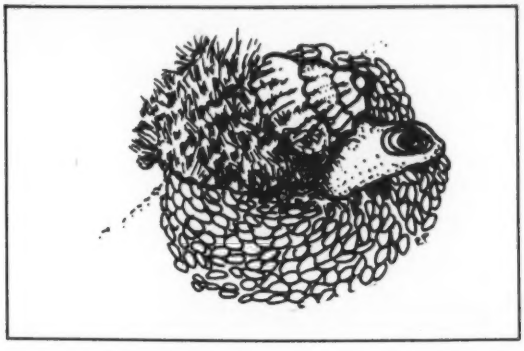
2. Ask students to hypothesize how the shell might get such a hole. Could a person make similar holes? What is the nature of shells? (hard) What happened to the animal inside the shell with the hole? (eaten)

3. Explain that some univalves are predators that eat other mollusks. One such predator is the moon snail, which attaches itself to mollusks and slowly drills a hole in the shell with its radula. Some mollusks can fight back. Mussels try to "tie down" the moon snail by attaching byssal threads to its shell.

4. Play a variation of "frozen tag" imitating the moon snail, mussel and byssal thread. Have most of your class be mussels. Start with three moon snails and one byssal thread. Mussels must run in pairs, since they usually occur in clumps. In a large, open space such as a gymnasium, the moon snails chase the mussels. When tagged, both the moon snail and the mussels freeze, holding hands. The moon snail and the mussels must stay attached until the moon snail counts to ten. If a byssal thread touches the moon snail before counting to ten, the mussels are free and the moon snail becomes a byssal thread. If the moon snail successfully completes the count to ten, the mussels become moon snails. Play ends when there are no longer any moon snails or mussels (or when everyone is tired).

5. Discuss worksheets and moon snail parts.

Activity 4
Hairy Triton - Name That Shell



Hairy triton:

The hairy triton (Fusitriton oregonensis) occurs frequently on Alaska beaches. Students can recognize them by their delicate pink shell, covered with a brown periostracum (outer skin) that has many stiff, bristle-like projections.

Materials:

- hairy triton shell
- smooth mollusk shell
- 2 paper lunch sacks
- worksheet:
  ...Hairy Triton (3D)

Procedure:

1. Have students, one at a time, put their hands simultaneously into one bag with a hairy triton, and into another with a different mollusk. Without revealing the name of either shell, have students give one word for differences in how the two shells feel. Continue until students run out of adjectives.

2. Using the same procedure, ask for words that describe similarities. Prompt both with questions about texture, shape, hardness and size.

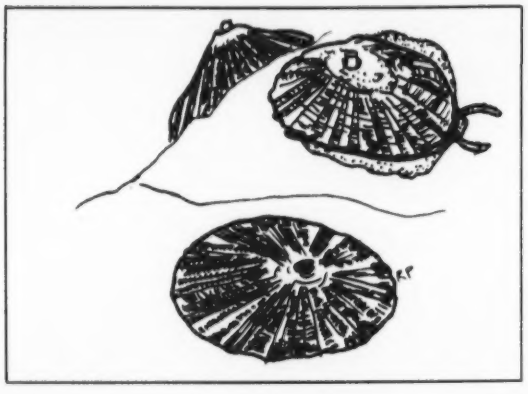
3. Reveal the shells. Ask students to help you name the hairy triton, using some of the descriptive words already elicited. Write these names on the board.

4. Explain that a commonly used name for this shell is "hairy triton," then write it on the board. Explain that in ancient Greek mythology, the triton was a being who lived in the ocean; consequently, "hairy triton" means "hairy one that lives in the sea."

5. Compare this meaning with the names the class thought of. Emphasize that their name ideas can be just as appropriate as the one in common usage, as names are decided simply to help people understand what others are talking about. But ask the class what would happen if students and teachers changed names every morning!

6. Use the Hairy Triton worksheet to review.

Activity 5
Limpets



Also known by the descriptive name of "Chinamen's hats," limpets (Diodora aspera, Acmaea mitra) can be seen almost anywhere along the Alaska coastline, clinging to rocks as they graze on algae. Because individual limpets of each species can vary in size, coloring and markings, it is difficult to tell the species apart. Alaska has several, and maybe even some hybrids! Students usually are interested to learn that in addition to the larger limpets common on rocks, tiny versions of the same animals can be seen clinging to eelgrass and seaweed.

Materials:

- limpet shells
- pictures or photos of limpets
- construction paper
- crayons
- scissors
- tape
- worksheet:
  ...Limpet (3E)

Vocabulary:

- limpets
- radula

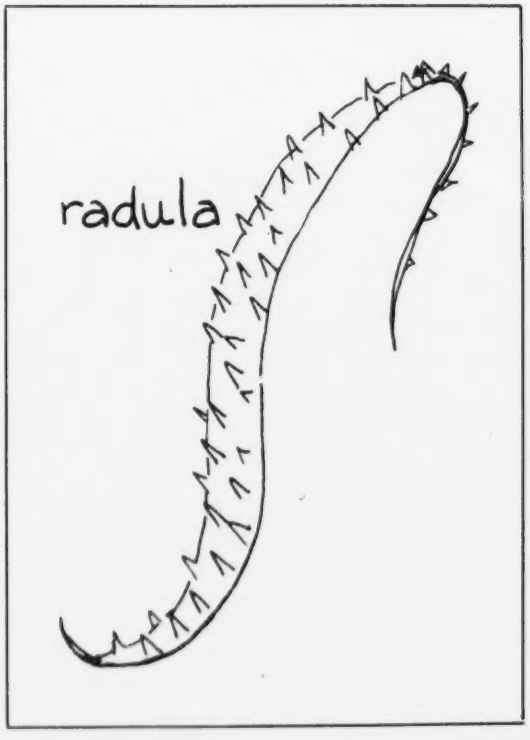
Procedure:

1. After showing the limpet shells, pictures and worksheet, discuss the great variations among the shells.

2. Have students draw limpet features on oval pieces of paper, using the red shells as models.

3. Cut the limpet illustrations to the center of the oval and overlap the edges, taping them together to form three-dimensional limpets.

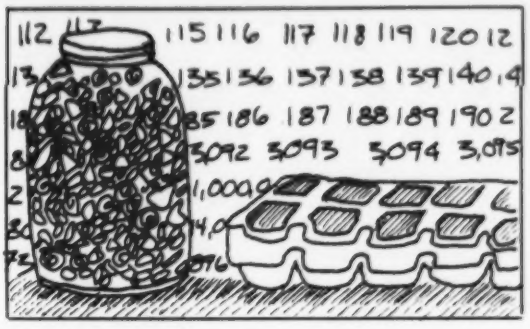
4. The teacher can make a radula ahead of time, or roughly sketch one now, explaining that it is the key to limpet survival. The limpets wander over rocks or seaweed at night, scraping algae.



5. Have students simulate limpets returning to their resting spots after a night of scraping. Line up students on one side of the room. Take two of the students' limpets. Have a student close his or her eyes and place the radula under one limpet. The student opens his or her eyes, and then guesses which limpet covers the radula. A correct guess allows the student to take one step forward. For an incorrect guess, the student remains still. Let each student guess in turn. The object is to reach the other side of the room before morning arrives. The winner is the first to reach the opposite wall. Urge students on by saying the sun is coming and that morning will soon arrive. Once students get the hang of the game, you can split them into groups of four or five, with one student taking over hiding the radula. The winner then becomes the radula hider.

6. Discuss and color the worksheet.

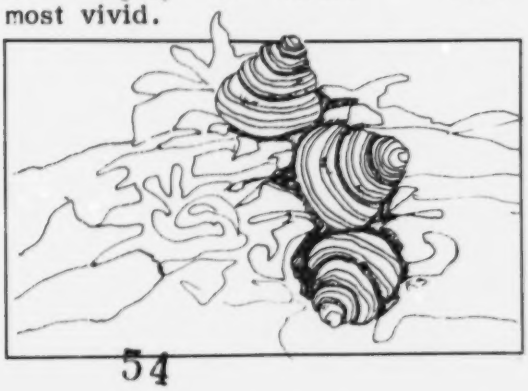
Activity 6
Count the Snails



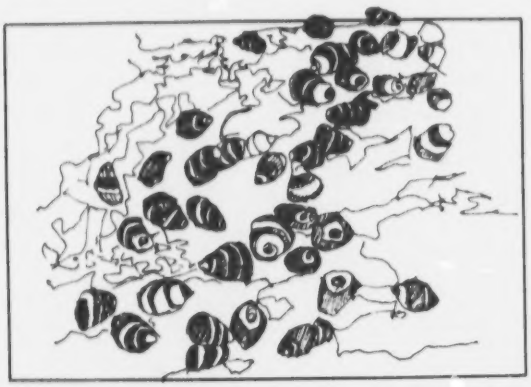
Background:

Rocky tidepool areas visited on field trips generally contain hundreds of thousands of small snails often overlooked by youngsters distracted by the more conspicuous tidepool life. Many of these small snails are strikingly beautiful, and worth a closer look. They can be found grazing among the rock algae. The majority of Alaska gastropods are less than 5 mm in greatest dimension. Adults are sometimes as small as 0.8 mm. Some of the more notable small snails include:

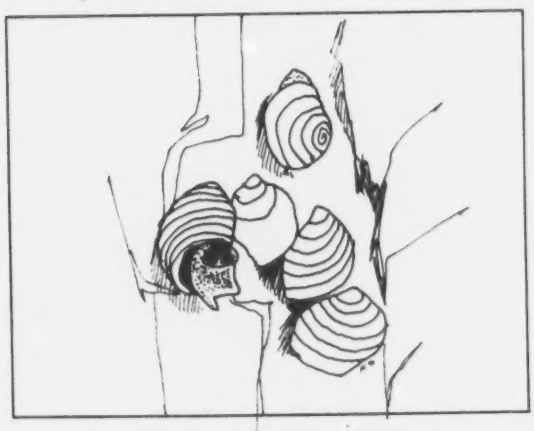
Margarite pupillus. Sometimes called the "pearly snail," this is one of the prettiest. Its shell is pinkish when wet, and pinkly or bluishly iridescent inside. For classroom viewing, a dish of water will display the colors at their most vivid.



The wide-chink, or Lacuna carinata, is a very small, smooth snail, usually dark brown. Students probably will notice its egg cases before they see the snails themselves. The cases look like tiny, yellow (or light green) doughnuts adhering to seaweed. If you look at them with a hand lens, the cases reveal many tiny dots--eggs actually--inside the jelly-like "doughnuts."



The Sitka periwinkle (Littorina sitkana) comes in a variety of colors and markings, often dark brown, sometimes with orange or gold bands. Intertidal snails, periwinkles are found high up on the beach--on rocks, pilings, driftwood or seaweed. If the sun becomes too warm when the tide is out, the periwinkle can crawl down under the moist seaweed and close its operculum.



Periwinkles not only can stay out of water for a long time, they need to be out of water part of the time. The littorines are something between a sea creature and a land creature, able to spend about half their time out of water. If kept in a pan of water, they will climb up the side--and sometimes right on out!

Materials:

- many little snail shells collected from beach (beach pebbles can be subsituted if snails are not available)
- egg cartons (one per student or group of students)
- glass "pickle" jar

Procedure:

1. Show students a jar full of snail shells and have them guess how many there are. Offer a prize to the person guessing closest, or offer to let that person do the activity first. (Count the snails with students or have them counted ahead of time.)

2. Give each student or group of students an egg carton and a pile of shells.

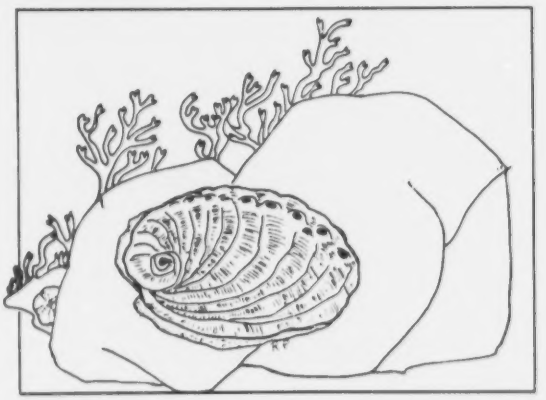
3. Have students arrange one shell in the first compartment, two in the second, three in the third and so forth until all are filled. (If the shells are too big to fit twelve into the last compartment, cut cartons in half or have one kind of shell equal five or 10 others.)

4. Have students count or add how many shells they have in all.

5. Use the shells and boxes to illustrate math problems through exercises, such as having students add two to the five compartment, or removing four from the nine, and so on.

6. Additional activities include organizing snails in compartments by color, size, type or other characteristics.

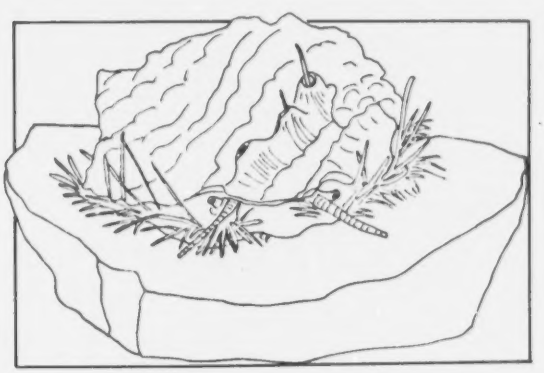
Activity 7
Abalone



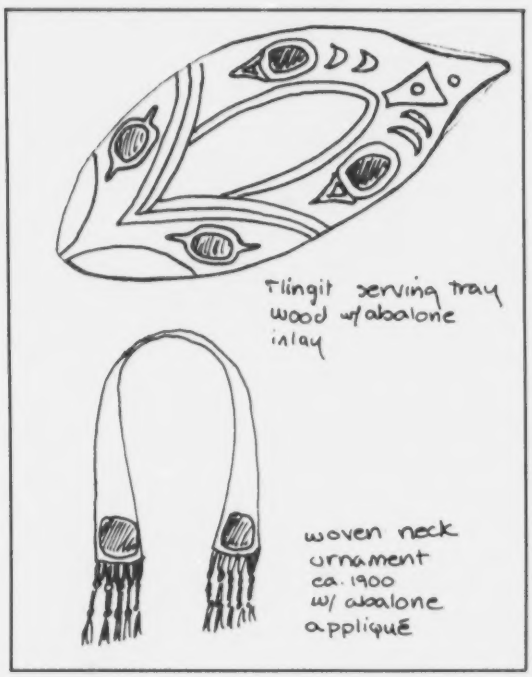
Background:

Only one abalone species lives in Alaska, and it is found solely in the southern part of the state. Also known as the northern abalone, the pinto abalone (Haliotis kamtschatkana) lives in rocky areas near enough to shore so that its habitat is sometimes exposed by low tide. Like the limpet, it scrapes its food from rocky surfaces.

The outside of the abalone's shell is dull red and green, and is often overgrown with other sea plants and animals. The inside of the shell is irridescent with "mother-of-pearl."



Abalone are good to eat, and in some places in Southeast Alaska are gathered commercially by divers. They are also harvested traditionally by southeastern Alaska Natives for food and for their shiny shell. The "mother-of-pearl" was used for decorating clothes and objects for ceremonial use. These early Alaskans traded with people of California for their abalone, which was larger, heavier and a different color than the Alaska species. Look for both kinds in Tlingit museums.



Abalone are quite susceptible to overharvesting, depleting stocks considerably. According to John Valentine, a Ketchikan biologist, abalones have not fared well anywhere in the world. In an effort to maintain stocks in this state, the Alaska Department of Fish and Game split the harvesting season for the first time in 1983-1984. Abalone conservation should be stressed in both field and classroom lessons on abalone.

Materials

- abalone shells, or pictures of abalone
- worksheet:
- chalk and chalkboard or newsprint and marker
- 20-50 buttons
- pie pan or plate
- bowl

Vocabulary

- money
- exchange
- mother-of-pearl
- trade

Procedure

1. Introduce abalone to students using worksheet, abalone shells, or pictures.

2. Ask students what they notice about the shells (whales in the shell, colon, irridescent inside). Key in on irridescence, and label it "mother-of-pearl". Explain that early Alaskans also thought it pretty, and valued it highly.

3. Have students help you make a list of things they would use the pretty shells for. Circle those uses that Alaska Natives might also have done if they are not on the list. Add decorate clothing, addresses, rattles, wooden serving dishes and other cermonial items.

4. Introduce the concept of trade that Alaska Natives used to collect abalone and other shells, such as dental (see Unit One, Activity Three). They exchanged these "treasures" for items they could not gather them-

selves. With students, generate a list of items that coastal residents could have traded for, from such differing groups as: 1) Russian and American traders (e.g., wool blankets, beads, steel knives and axes), or 2) interior or northern Natives (e.g., moose, caribou, marks, furs and hides, musk ox horn, birch bark containers.)

5. Ask students to estimate how many shells would have been necessary for one wool blanket, one beaver pelt, one knife, and so on.

6. Inform students that today, divers collect abalone and get money for them, instead of trading them for goods. Ask students how many abalone they think would pay for a bicycle, a record album, or an ice cream sundae. At the 1984 price of abalone ($2.40/lb or approximately .60/abalone), it would require the following number of abalone to purchase the listed items (at 1984 Fairbanks prices):

   . ice cream sundae ($3.25): 5
   . plastic sled ($12.): 20
   . aluminum soft ball bat ($40.): 67
   . bicycle ($185.): 308
   . three-wheeler ($1700.): 2833

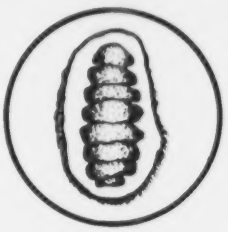
7. Demonstrate stock depletion by placing a few handsful of buttons, pokerchips or similar items in a bowl. Cover the bowl with a pie pan or plate. Place some of the buttons in the plate. Set some buttons aside. The buttons represent abalone, the bowl represents the ocean, and the plate represents shallow water.

   Ask a few students to come up and collect some, even all, of the abalone in the shallow water.

   Move some of the buttons from the bowl to the plate to represent migration from deep water reserves, and throw some buttons into the bowl to represent reproduction. Repeat the process a few times, discussing the importance of deep-water reserves.

8. Explain to the class that divers can now gather abalone from deeper in the ocean. Remove the plate and have your "divers" remove abalone directly from the bowl. Ask students what could happen now? (button abalone could be used up). Discuss management strategies that would still allow harvest, yet would not wipe out the abalone population.

Unit Four
Chitons



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Chiton 4A

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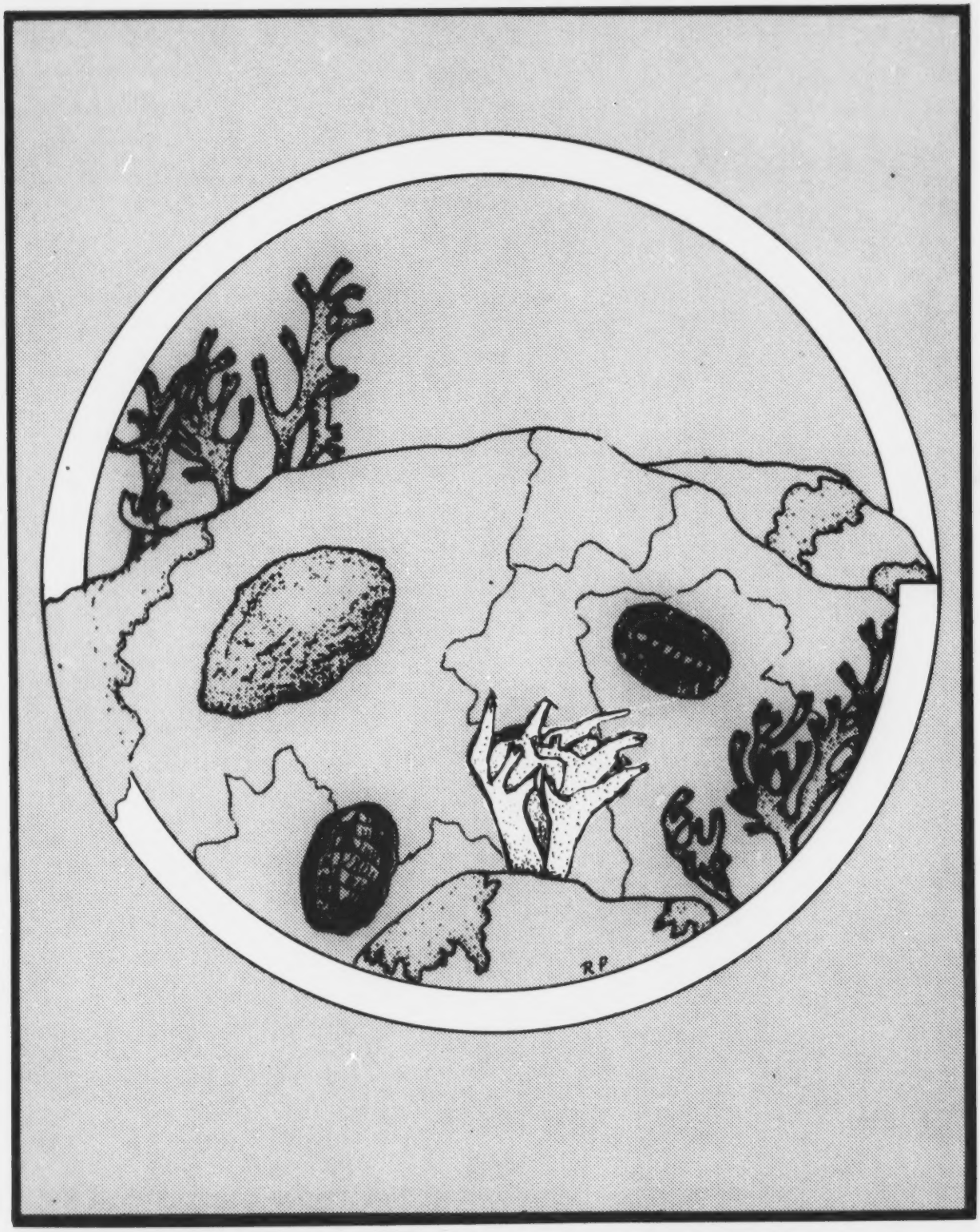
Objectives:

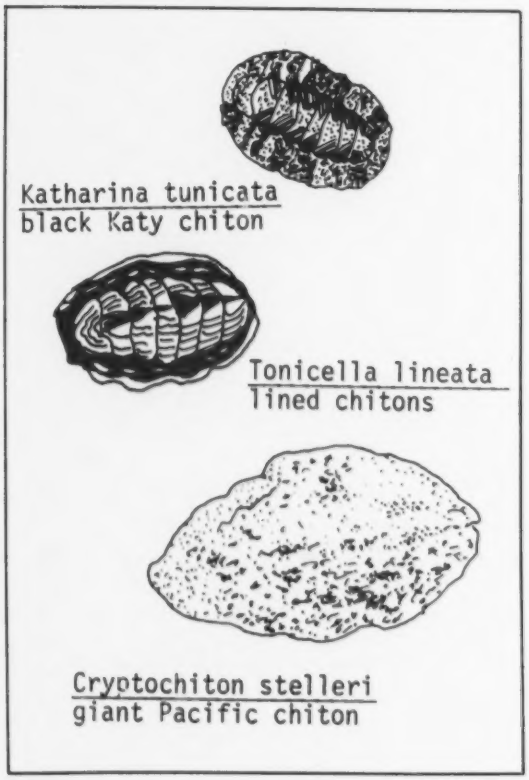
To help students:

- Demonstrate understanding of the distinguishing characteristics of a chiton, by making a clay chiton (Activity 1).
- Measure chiton lengths with rulers (Activity 1).
- Compare chitons with other mollusk groups (Activity 2).
- Recognize a number of local chiton species (Activities 1, 2).
- Explain how and where a chiton usually lives (Activity 3).
- Act out the chiton's diurnal cycle in a game (Activity 3).
- Make a chiton button with a chiton phrase (Activity 2).

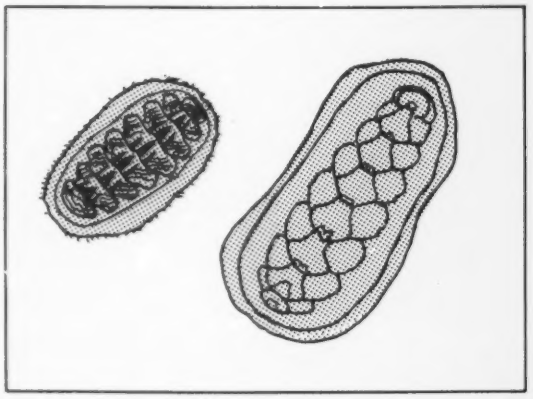


Unit Four: Chitons. (Left to right): giant Pacific chiton (Cryptochiton steller, lined chiton (Tonicella lineata), black Katy chiton (Katharina tunicata).

"Chitons" (pronounced KI-tuns) are neither bivalves nor univalves. They have eight valves, or plates, and represent the class Polyplacophoro. Alaska's two largest chitons, the black Katy chiton (Katharina tunicata) and the giant Pacific chiton (Cryptochiton stelleri) have long been used as food by Southeast Alaska Indians. Both are sometimes called "gumboots" because they resemble the high rubber boots often worn by seamen. Chitons also are used as fish bait. Another type of chiton found in Alaska is the "sea cradle." If removed from the rock to which it clings, it will curl up like an armadillo! Chitons are known by a few different names, such as "armadillos of the sea," "coat-of-mail shells" (the Greek word 'chiton' means 'coat of mail,' or 'tunic'), "cat's cradles," and "lined chitons" (Tonicella lineata).



Activity 1
Clay Chiton



Materials:

- chiton pictures
- chiton specimens
- clay
- rulers
- pencils
- worksheet:
  ...Chiton (4A)

Procedure:

1. Pass out the worksheets, shells and pictures.

2. Ask students what they know about chitons. How can they tell it is a mollusk? (external shell, soft body, a large muscular foot)

3. Have someone count the number of plates, or valves. Make it clear that chitons always have eight plates, but sometimes the plates may be partially or completely hidden from view by other parts of the body.

4. Pass out rulers. Have students measure the chiton lengths. Which is the longest? The shortest?

5. Continue examining the chiton pictures and shells, and discuss and complete the worksheet.

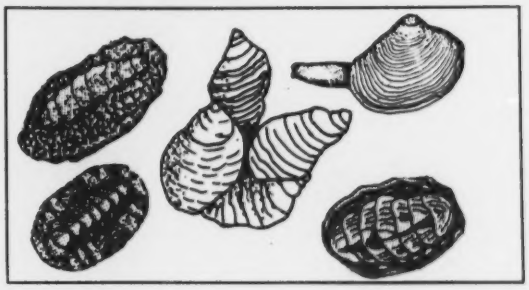
6. Relying on specimen and worksheet models, help the students make clay chitons.

7. Ask if any students have seen chitons on the beach. If so, where? Their clay chitons should be shaped to best attach to rocks. Explain that chitons are well-suited for living on rocks in the intertidal zone, where they are continually beaten by strong waves. Both the chiton's flexibility and low profile allow them to cling tightly to rocks with little resistance to waves that might otherwise sweep them away.

8. Students can use pencils to draw the plates on the back of the clay chitons, and to write their initials on the undersides.

9. Arrange the students' chitons on a rock for display.

Activity 2
Distinguishing Chitons



Materials:

- chiton shells or pictures
- univalve shells or pictures
- bivalve shells or pictures
- paper
- crayons

Procedure:

1. Distribute or display chiton shells.

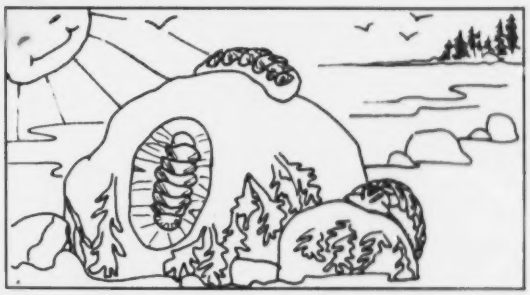
2. Write "univalve," "bivalve" and "chiton" on the board. Ask students to list ways the three types of mollusks are the same, and write the similarities under the headings.

3. Ask for differences. Use such comparisons as texture, shape, color, number of valves, and diet.

4. Ask students what they think it would feel like to be a chiton. What would they think most about?

5. Have students design chiton buttons containing a rhyme, catch-phrase, or slogan.

Activity 3
Sun's Up Chiton



Background:

(The game within this activity is a variation of the game "red light-green light.")
Chitons leave protected crevasses to graze at night. By sunrise, the chitons have returned to their nook-and-cranny homes.

Materials:

- large playing area

Procedure:

1. Ask students where they find chitons. Have they ever seen chitons move? If so, when? (evening or night?) Why would they move? (to eat as they are grazers and are scraping algae from rocks) Why don't they feed during the day? (exposure to predators and dehydration from sun)

2. Have students role-play chitons. Choose one student or yourself to be the sun.

3. Line students along one side of the playing area. The sun stands across from the chitons, facing them. The chitons' "home" line is even with the sun.

4. The object is for the chitons to reach their home line. They may do this only at night when the sun's back is to them.

5. The sun turns its back to the chitons. "Nighttime," says the sun. While doing so, the chitons move forward.

6. "Sun's up," the sun says, and faces the chitons. If the sun sees any chiton moving, that chiton must go back to the starting position.

7. The first chiton to reach the home line becomes the new sun.

Unit Five
Cephalopoda

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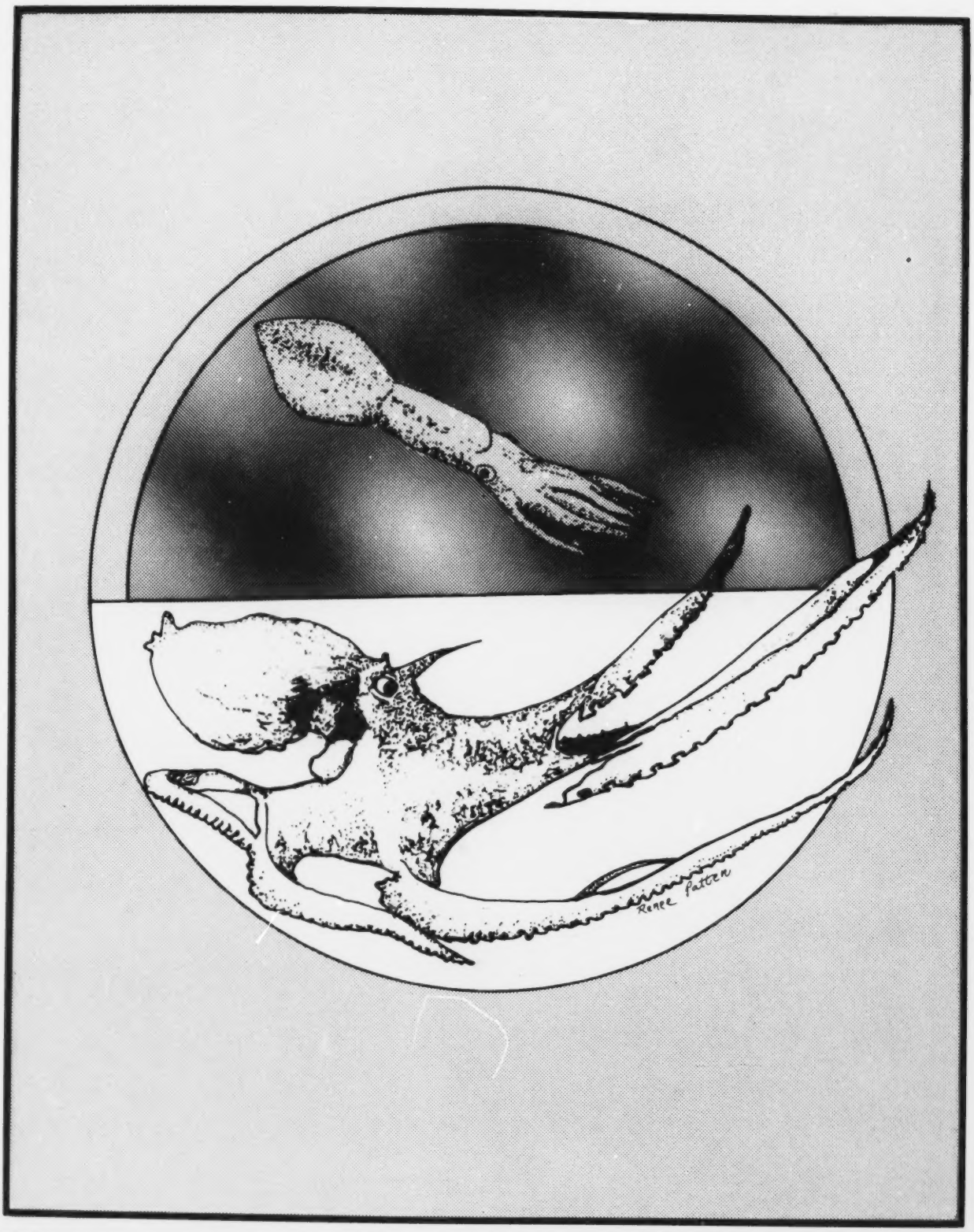
Objectives:

To enable students to:

- Identify the octopus and squid (Activity 1).
- Explain cephalopod habits and habitat (Activities 1, 2).
- Demonstrate knowledge about the life of an octopus by creating a story and play (Activity 3).
- Study food-chain basics (Activity 2).
- Envision the world of the octopus through art, crafts, games and song (Activities 2, 3, 4, 5).

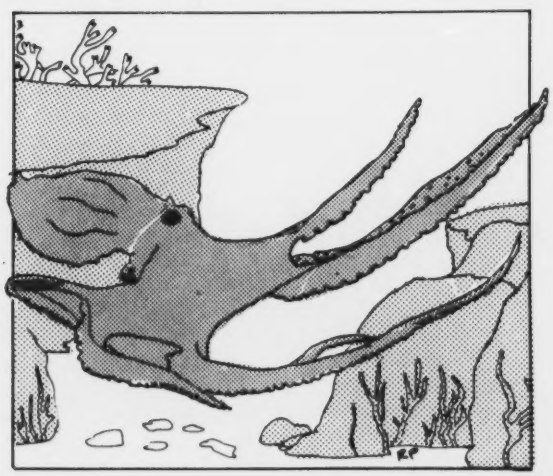


Unit Five: Cephalopods. Squid and octopus in sea and ecology, and in art, music and sport.

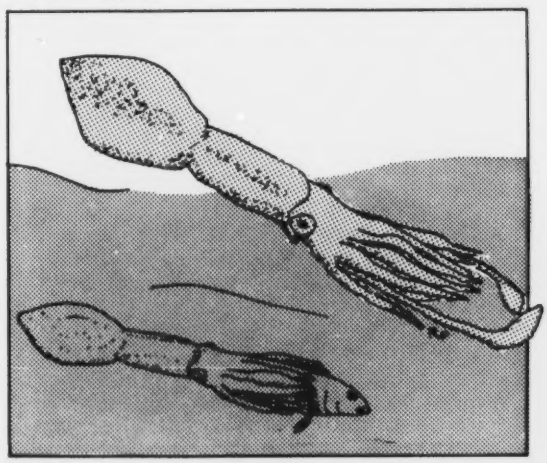
Cephalopods, which include such animals with spooky reputations as the squid and the octopus, are graceful, curious-but-shy creatures that can change colors in a split second. They can also crack crab with strong, bird-like beaks, stare about the ocean with human-like eyes, and swim by jet propulsion. The cephalopods range in radial spread from a few inches to as much as 32 feet.

In the octopus, special pigment cells called "chromatophores" can be expanded and contracted to change the octopus from white to deep red in one-tenth of a second. The squid, too, can change color, through a bioluminescence that enables it to "blink"--from a glowing white, to red, to green.

Considered the most intelligent invertebrate, the octopus has an advanced nervous system, as well as eyes similar to humans'. The octopus is curious about its surroundings, but is usually shy when approached. It is undeserving of its reputation of ferocity, even though both the octopuses and squids have sharp beaks strong enough to crack crab, and arms long enough to be used both to capture prey and transfer food to the mouth.



The squid, unlike the octopus, has eight regular arms, plus two long tentacle-like arms. The tentacles are used to capture fish, the arms to hold the food. The squid also has a fragile internal-shell remnant that the octopus lacks. This squid "bone" is ground up and used in toothpaste. Squid beaks are the cause of ambergris, which is a perfume fixative taken from the intestine of sperm whale. Ambergris is formed when the squid beak becomes tangled in the whale intestine. Some squid in Alaska seas spend their entire lives in open water. Another species, a tiny animal that grows to only about four inches long, lives on the ocean floor. The eggs of squid that live in open water drift freely, but the bottom-dwelling squid lay their eggs in clusters on the sea floor. Unlike the female octopi, however, the female squid do not guard their eggs.



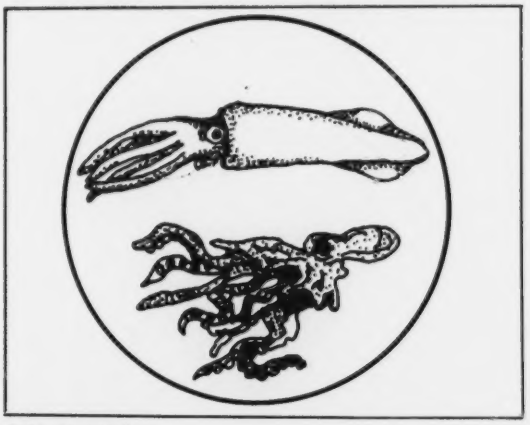
Female octopi do not eat for the six months that they tend their eggs in caves; some die soon after the eggs hatch.

Octopi and squid protect themselves by ejecting dark ink, which forms a protective fog in the water. This ink used to be

gathered from squid in the Mediterranean and sold as sepia ink. Though squid ink is no longer gathered commercially, Diane Tillion, an Alaskan artist, collects octopi in Kackemak Bay and uses their ink as a medium for her art.

Both squid and octopi are eaten by people in many parts of the world. Japan, Newfoundland and Spain have commercial fisheries for squid. The annual squid and octopus harvest worldwide represents the world's second largest fisheries harvest. (Oysters are number one.) Alaska imports millions of pounds of octopus from Japan every year for use as bait in halibut fishing. Some people are considering starting an octopus fishery in Alaska.

Activity 1
Introduction to Cephalopoda



Materials:

- octopus and squid pictures
- "The Octopus" film (distributed by Time-Life Video Distribution Center, 100 Eisenhower Dr., P.O. Box 644, Pasamus, NJ 07652)
- octopus and squid specimens (available from grocery stores or local fishermen)
- octopus puppet (see Unit Seven, Activity 1, or Lunch Bag octopus; Unit Five Activity 3)
- worksheets:
  ...Octopus (5A)
  ...Squid (5B)

Vocabulary: NOTE: The various spellings and usages of the words octopus and squid can be confusing. Generally, the plurals are octopi and squid. The alternate plurals, "octopuses" and "squids," are used when referring collectively to more than one species of either octopus or squid (as in "the widely varied octopuses and squids of the Pacific Ocean").

- mollusk
- Cephlapoda
- tentacles

- suction cups
- beak
- eyes

Procedure:

1. Using the puppet 'Spineless,' (see Unit Seven, Activity 1) introduce the octopus to the class as a member of the mollusk community.

2. Ask students what they know about octopi. Make a list of questions on the board, and record the class's initial response.

   - Is the octopus timid and shy, or fierce and scarey?
   - Is the octopus a devoted parent?
   - Does the octopus eat people, fish, crabs, or something else?
   - Are all octopuses big?
   - Where do octopi live?
   - Are octopi, with their many legs, clumsy and awkward or graceful swimmers?
   - Are octopi always the same color or can they change colors?

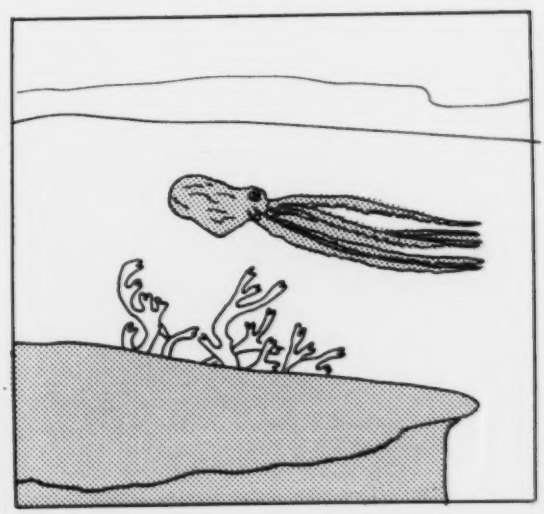
3. Show "The Octopus" film. After the film, review the questions written on the board.

4. Discuss octopus and squid similarities and differences.

5. Use the specimens to point out octopus and squid parts, and elaborate on behaviors pointed out in the film.

6. Pass the octopus or squid around on a tray. Have students examine the tentacles, suction cups, beak and eyes.

7. Use the Squid and Octopus worksheets for review.



Activity 2
Hot Dog Octopus

Materials:

- hot dogs
- knife
- pot
- water
- heat source
- worksheet:
  ...Hungry Octopus Song (5C)

Vocabulary:

- octopus
- squid
- food chain

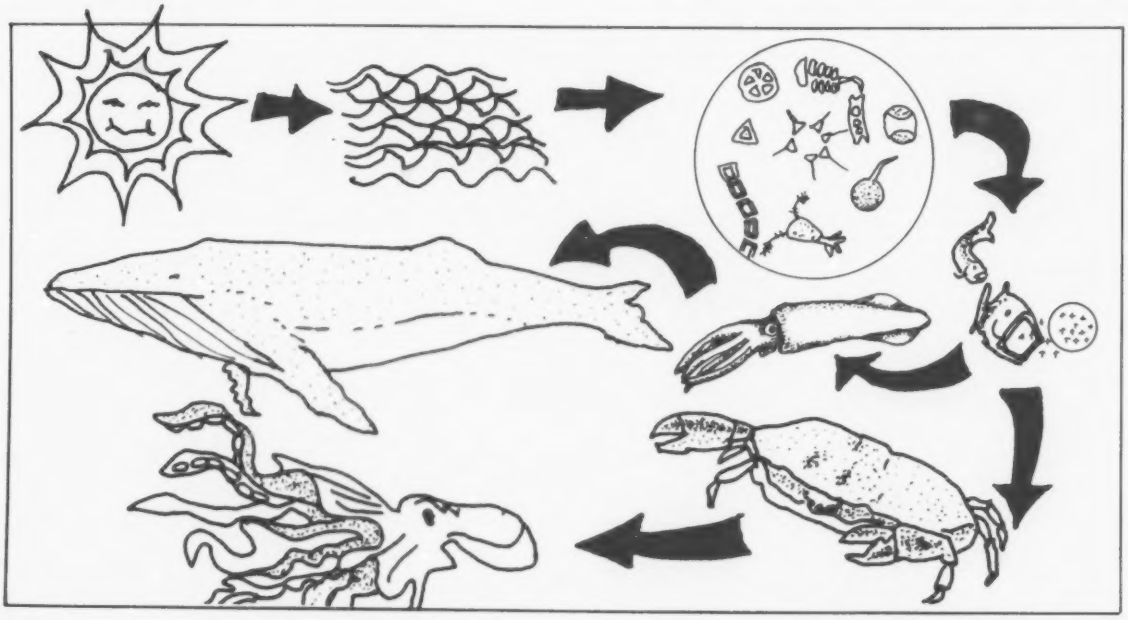
Procedure:

1. Ask students if they would like to eat octopus or squid. How do their attitudes differ regarding chicken, beef, crab or fish? What does the octopus eat? (crab) Has any of them ever eaten crab? Some squid eat fish and are in turn eaten by whales.

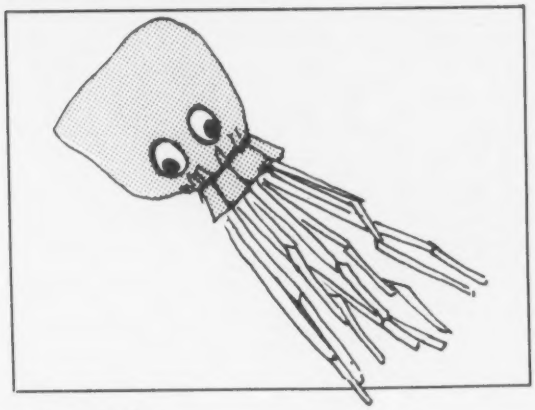
2. Show students how the ocean community is linked together by a food chain, using the examples illustrated. What would happen to the octopus if there were no crabs?

3. Slice the hot dogs into quarters (as shown) for about two-thirds of their lengths. Boil. The "legs" will turn outward. Note that while the hot dog looks like an octopus, the real octopus will have twice as many legs.

4. Sing the Hungry Octopus Song and eat the hot dogs.



Activity 3
Lunch Bag Octopus



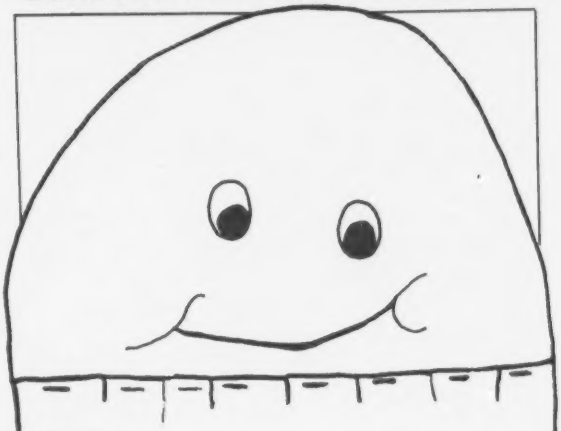
Materials:

- lunch bags
- scissors
- felt-tip marker
- construction or butcher paper
- tape
- newspaper or scrap paper

Procedure:

1. Stuff the paper bag with scrap paper or newspaper, and tie the open end shut. Draw eyes.
2. Cut 12-inch strips of the construction or butcher paper for legs. Weave two strips together.
3. Tape, glue or staple eight legs to the bottom of the bag.
4. Use these octopi as characters for a play. Initiate the play by asking students what it is like to be an octopus. Create the play by doing a chain story. Have one student start with a segment in the life of an octopus. Each student then in turn adds an "act" or incident.

Activity 4
Construction Paper Octopus

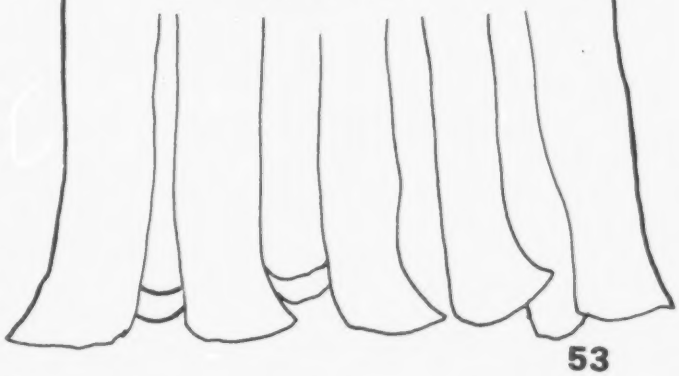


Materials:

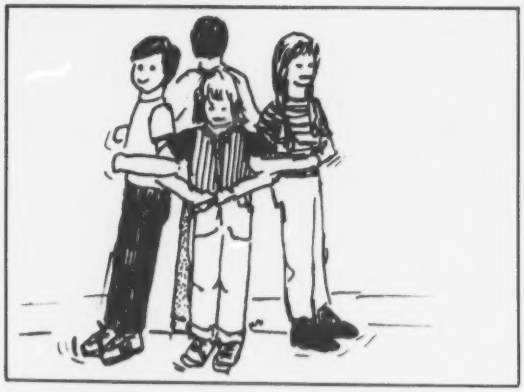
- scissors
- construction paper
- crayon

Procedure:

1. Cut out a dome-shaped piece of paper for the "head" of the octopus.
2. Cut eight strips of construction paper for legs. Curl the legs by wrapping the strips around a pencil or crayon, or by using a scissor edge.
3. Fasten legs to head.
4. Use these octopi as covers for Sea Week workbooks or hang them decoratively.



Activity 5
Octopus Race



Materials:

- enthusiasm
- energy
- large, open space

Procedure:

1. Ask students how many legs an octopus has. (eight) How many do each of the students have? How many students will it take to make an octopus? Divide the class into groups of four (with maybe a six- or 10-legged octopus thrown in, so no one is left out).

2. Arrange four students as a demonstration to illustrate how an octopus is formed. Have each of the four stand with his or her back to all the others, then link elbows, with the students on each side.

3. Have each group of four arrange themselves into an octopus and then practice moving.

4. Line up the students, then draw a parallel line about 20 or 30 yards away.

5. The race is on! The winning octopus must run to the opposite line and return with all its legs.

6. For greater challenge, begin the race with the octopi sitting, then standing and maneuvering past obstacles during the run.

7. Discuss the complexity of the octopus nervous system, which must control all these legs. Was it easy making eight legs work together? Octopi are the "smartest" of all invertebrates.

Unit Six
The Seashell Field Trip

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Objectives:

To give students opportunities to:

- Experience the magic of the water environment. Demonstrate respect and appreciation for water animals and their homes by designing beach rules (Activity 1).
- Make a plankton net (Activity 2).
- Help design field investigations of interest (Activity 3).
- Explore the beach (Activity 4).
- Watch the feeding habits of bivalves (Activities 5, 6).
- Observe mollusks in their natural environments (Activities 4, 7, 11).
- Record field data on mollusk observations (Activities 3, 8, 11).
- Collect field information and materials for follow-up work in the classroom (Activities 10, 13).
- Discover the life in a drop of water (Activity 10).
- Show their understanding of mollusk habits through pantomime (Activity 12).
- Review their mollusk learnings and share special moments (Activity 13).

73 Unit Six: The Seashell Field Trip. Students explore and study diverse beach habitats to find a variety of mollusks and other coastal denizens.

"If there is magic on this planet, it is contained in water," writes author Loren Eisely. Children can share in this magic through field trips to local beaches, ponds and streams, especially when complemented by adequate classroom preparation and follow-up.

Field trips provide hands-on learning. In addition to stimulating both scientific observation and accurate recording skills, they also facilitate group interaction and cooperation. Field trips are therefore the fulcrum of Sea Week lessons.

Whereas the introductory activities prepare students to take better advantage of field-site learning, the review activities reinforce the field trip for better learning retention.

For logistics and organizational tips for field trips, see "Tips for Teachers" at the beginning of this volume.

Adequate preparation cannot be understated, so be sure to cover planning activities in units One through Five. Additionally, you may find it useful to:

- Set learning objectives for the field trip and develop a lesson plan (as for any other curriculum unit).
- Agree on specific tasks and investigations that are of interest to all, and review them for procedure before the actual trip.
- Have students bring raincoats, boots and additional items from home the day before the field trip.
- The day before your field trip, have a "fully dressed" practice run. Split the class into groups, assigning responsibilities and equipment to each group. Have each student choose a "buddy" for the following day.

As with any learning experience, students respond best to diverse learning modes. So, while on the beach, plan for periods of "exploration" as well as structured time. Lead students in discussions covering your learning objectives. Provide time for individual, small-group, and large-group activities.

Be sure to repeat visits later to the same area, bringing to each investigation a different focus. Overall, try to foster a familiarity that will lead to a sense of stewardship.

Making a "beach book," designed to record beach observations and artwork developed over the seasons, will give students a tangible memory of their beach. If the site is close by, students can be encouraged to visit on their own and bring reports back to class.

Activities 1 to 3 are designed to prepare for the trip. The remaining activities are for the trip itself. They fall into four categories:

I. Initial Exploration and Discovery. Individual free time to satisfy the natural exploration impulse (Activity 4).

II. Structured Learning Activities. Of two types: 1) group observation and experiments, which require limited supplies or teacher supervision (Activity 5-10); and 2) individual and small-group tasks and data collection, under the guidance of volunteer chaperones.

III. Games. Group amusement--a chance to bring students together to socialize and burn off excess energy (Activity 12).

IV. Review. Group synthesis--to review the day's learnings and to share feelings and experiences (Activity 13).

Activity 1
Beach Etiquette

Background:

Students will be better stewards of their environment if they put some thought into stewardship, and will be more likely to pay attention to rules if they play a role in formulating them. Use the conservation and beach etiquette sections of the Sea Week Source Book as background.

The primary motivations for beach etiquette and conservation are to promote care and respect for living things and their homes.

Remind students that the beach is the home of the mollusks they have been studying.

Materials:

- paper
- pencil
- chalkboard or newsprint
- worksheet:
  ...Ounce of Prevention (6A)

Vocabulary:

- conservation
- safety
- natural resource
- respect

Procedure:

1. Write "conservation" on the board. Define it as "wise use of our natural resources." Also introduce and define "safety."

2. Explain that one natural resource is the beach. Have students help you list ways in which the beach is a resource. (by providing food, animal homes, human recreation, and a buffer zone that protects coastline communities)

3. Ask students to list creatures that live on the beach. Discuss manners, and ask the class what constitutes appropriate behavior for visiting someone else's home. Is it polite to break things at a friend's house, or step on things without looking?

4. Divide students into groups of four. Remind students that studying the beach beforehand shows respect for the things living there. Explain that this will also make the class visit there a safer one. Have each group then come up with two rules that will keep the beach a good place to visit. Request that the students word these rules in ways that will make everyone want to follow them.

5. Ask each group to write their rules on the board, or have the groups read them orally while you write them on the board.

6. Go over the rules, adding any you think necessary. Have the class agree on a list of major rules.

7. Read and study the following poem:

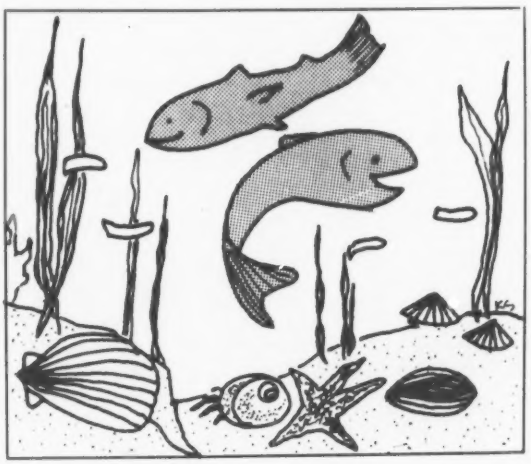
"Hurt No Living Thing"

Hurt no living thing;
  Ladybird, no butterfly,
Nor moth with dusty wing,
  No cricket chirping cheerily,
Nor grasshopper so light of leap,
  Nor dancing gnat, no beetle fat,
Nor harmless worms that creep.

-Christina Rosetti

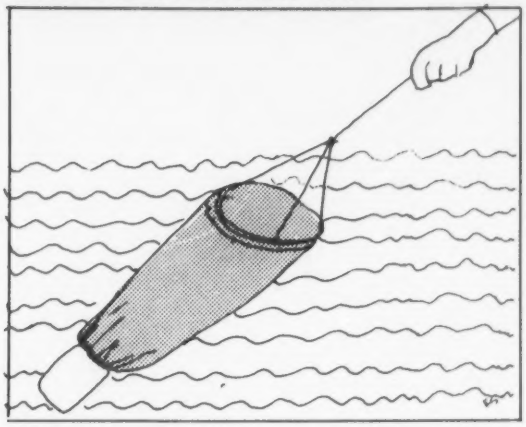
(The following additions are provided by Sue Baxter's class, Juneau)

Nor shellfish hard, no starfish scratchy,
  Nor fish that swim happily,
Nor limpet small, nor hermit crab pinching.
  Hurt no living thing!



10. Play the Ounce of Prevention game located with the worksheets.

Activity 2
Make a Plankton Net



Background:

Plankton are living organisms--tiny plants and animals--that drift or swim weakly in open waters. The word "plankton" is plural. An individual planktonic organism is called a "plankter."

Plankton are not microscopic by definition. In fact, jellyfish, which drift with the ocean currents, are among the larger planktonic organisms. The plankton your net will capture are the small microplankton, which constitute the "sea soup" that is the basis of the ocean food web.

By learning that microscopic plants and animals do exist, students can start to understand the basis for food webs in marine and freshwater systems. For example, microscopic plant plankton serve as food for tiny, swimming, animal plankton, which in turn serve as food for larger marine animals. This, of course, is the basic idea of the food chain. Humpback whales, for example, eat shrimp-like euphausiids that eat tiny animal plankton which eat microscopic plant plankton.

Materials:

- string
- needle and thread
- nylon hose or parachute nylon
- clothes hanger
- scissors
- wire cutter
- baby food jar and lid
- rubber band
- tape

Vocabulary:

- plankton
- net
- web
- chain
- organism
- microscopic
- bridle
- towline

Procedure:

1. Write "plankton" on the board. Explain that plankton consist of organisms, both plant and animal, that float in water.

2. Talk about which animals eat plankton. Students should recall from earlier exercises what bivalves do (and usually, they also remember from Book One that some whales eat plankton, too).

3. Cultivate anticipation by telling students they can catch plankton on this field trip and raise it in the classroom when they return.

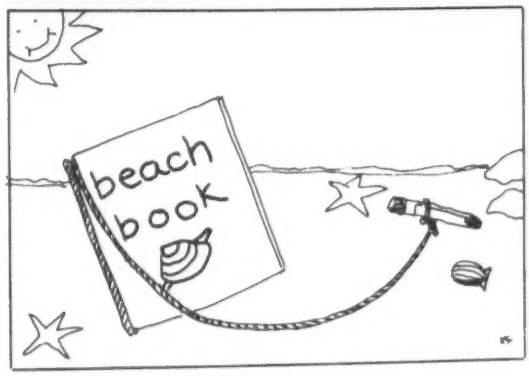
4. Make one or two plankton nets, with student help. First, cut and bend a piece of clothes hanger to form a circle six inches in diameter. Wrap the ends around the wire forming the circle, and then cover all sharp points with heavy tape.

5. Sew the upper, large end of a nylon stocking over the wire frame to form what looks like a wind sock. Cut off the foot, leaving about one foot of hose. Fasten the small end onto an open baby-food jar with a rubber band. (Save the lid for transporting specimen.)

6. Use three pieces of string to fashion a bridle as shown, and to the bridle attach a long length of heavy string or cord as a towline. You're now ready to go plankton fishing!

7. Explain the use of the net. Ask what will happen to the water when you pull the net. (It will flow through the nylon.) What will happen to animals too big to flow through the nylon? (They will get stuck on the nylon and then get washed into the jar.)

Activity 3
Beach Books



Materials:

- paper
- yarn
- scissors
- task cards copied on heavy paper
- plastic sandwich bags
- worksheet:
  ...Beach Book (6B)
  (copied onto heavy paper)

Procedure:

1. Ask students what they expect to find on the beach. Make a list. Pass out the Beach Book worksheet, and ask for suggestions on additions or deletions that would adjust the list to apply more specifically to your local beach.

2. Make "beach books." Have each student color a book cover and cut the pages apart (or cut them yourself ahead of time with a paper cutter). String the pages together with yarn and tie a crayon to the yarn. Put the book in a plastic bag.

3. Review the creatures in the book.

4. Instruct students to check appropriate boxes when they find the creatures, and perhaps write the number of creatures found in the space beside the box. Emphasize that all students are responsible for their own book, writing implement and plastic bag. Remind them not to litter the beach (as per one of the rules on the list they made earlier?).

Activity 4
Arrival Fun

After all this preparation, class work, organization and travel, you have finally arrived at the site! The students' first urge will be to get out and explore. Allowing them to act on this impulse might turn up some exciting finds and will make them more receptive to focusing later.

Materials:

- beach books
- litter bags

Procedure:

1. Before exploring, ask students to volunteer one beach rule until you have reviewed the complete list.

2. Allow students a specified period in which to explore. Be clear on the constraints: boundaries, time, group size. Suggest that they start on their beach books. Urge them to share their finds with the rest of the group, as well as to call them to your attention. Be sure to designate a rendezvous at the end of the exploration period. You may want to prearrange a signal to pull the group together

(such as a ship's bell, bosun's whistle, conch horn or raised flag). From 20 to 30 minutes is a good initial exploratory period, with the half-hour generally stretching to 45 minutes during regrouping.

2. Remind students of the importance of respectfully caring for the area. Pass out litter bags and encourage students to collect litter. Encourage students to share finds by calling others over to them, rather than their collecting everything they come across. This would also be a good time to remind students that this place is where many things and creatures call "home."

3. When you have regrouped, share your finds briefly. Use this time to go over behavior rules and expectations, and to outline the rest of the day.

Activity 5
The Life of a Mussel

Background:

This activity should be done as a group, in order to disturb as few mussels as possible.

Materials:

- live mussels
- bucket, plastic bowl or milk carton with seawater
- chalk or food coloring

Vocabulary:

- habitat
- plankton
- filter feeding
- byssal threads

Procedure:

1. Remind students of classroom discussions and worksheets on mussels. Ask them to now observe and report on the mussel's habitat. Ask where it is. (low tide? high tide? close to the water? far from the water? among sand? among rocks?)

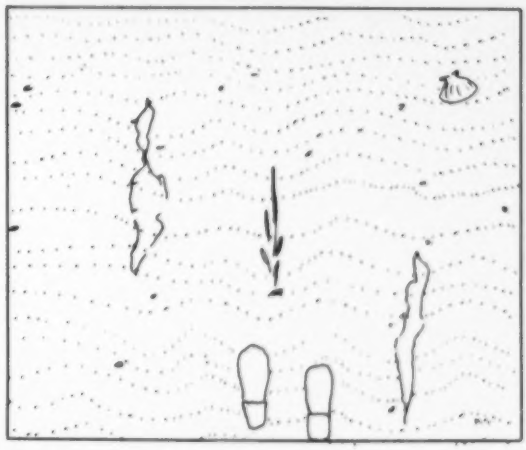
2. Explore a mussel habitat together. Ask what else they can find. (periwinkles? limpets? hermit crabs?)

3. Ask students what the mussels eat and how. (plankton, by filtering it from the water)

4. Place some mussels in the sea water container for observation. Let students help you demonstrate the movement of water into and out of the mussel, by dropping a few chalk particles, or a few drops of food coloring, near the gaping shell. Ask what happens. Experiment with different colored food coloring--do your mussels prefer one color over another?

5. Locate some byssal threads, explaining how entire mussel colonies are anchored by these threads. Have children pull some threads to see how strong they are. If left undisturbed for a while in the aquarium or bucket, the mussel may attach byssal threads. Periodically "post a guard" at the container, to watch for the mussel's slender, specialized foot, reaching out with a byssal thread, and then reaching in and out again with self-made glue with which to anchor the thread.

Activity 6
Find a Clam, Feed a Clam



Background:

Remind students that people eat clams. This is a good introduction to studying the clam's eating habits. Again, conducting this activity as a group will keep from disturbing more shellfish than necessary. What else are we eating when we eat a clam? The concept of the "food chain" applies here, as does a review of the habitat and food requirements introduced in the mussel unit.

Bivalves such as clams, which burrow into sand or mud, must extend their siphons to the surface to feed. The pressure of a human foot near the hole will cause the animal to retract its siphon. As it does so, water in the siphon will squirt upward, sometimes like a fountain.

Materials:

- shovel, clam rake
- live clam
- bucket, plastic bowl or milk carton
- cold sea water
- food coloring or India ink

Vocabulary:

- clam
- siphon
- foot
- habitat

Procedure:

1. Ask who among the students has eaten clams. Discuss what else they might be eating as they eat a clam. Ask what the clam had eaten.

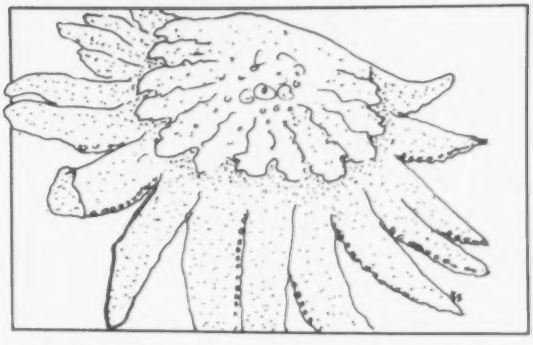
2. Encourage students to walk over sandy or muddy areas of the beach carefully, looking for siphon tips and holes left by retracted siphons. Have them watch for water squirts as the clams retreat. When they find evidence of a clam, help them dig carefully to uncover the one clam. Replace the mud in the hole to avoid suffocating neighboring clams.

3. Examine the clam, deciding what kind it is. First, place it in shallow water on the sand to see if it starts digging. Then place the live clam in a bucket of fresh, cold, sea water, watching to see if it extends its foot or siphon.

4. Introduce food coloring to the water and see if it is drawn into the clam through the incurrent siphon.

5. See how many different kinds of clams the class can find. Have students leave the clams where found. For each clam discovered, have students report on whether it was alive or dead, where it was found, and what the habitat requirements were for that particular clam.

Activity 7
Make an Abalone Run



Materials:

- abalone
- sunflower star
- tide pool or milk carton

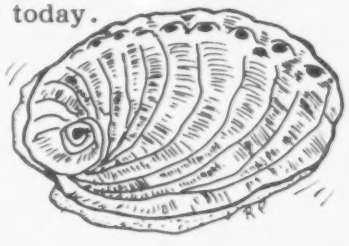
Procedure:

1. Find an abalone and a many-armed sunflower star at the beach.

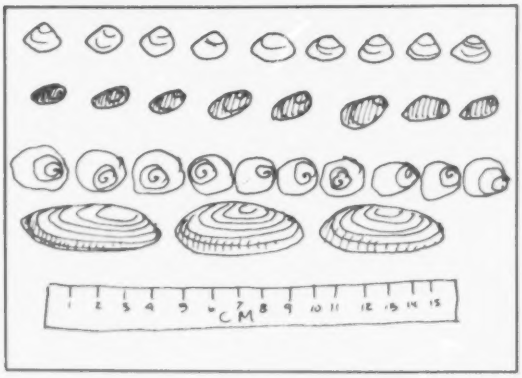
2. Put both animals in the same tide pool or in the same container of sea water.

3. Watch the behavior of the abalone. (Because sunflower stars eat abalone, the abalone may try to "run" from the star.) To encourage the retreat, touch one sea star arm to the abalone.

4. After you have watched the reaction of the abalone, put the animals back where you found them, so the star won't have an abalone "steak" for dinner today.



Activity 8
Beach Math
- Frequency Distribution



Materials:

- rulers
- pencils
- frequency distribution forms

Procedure:

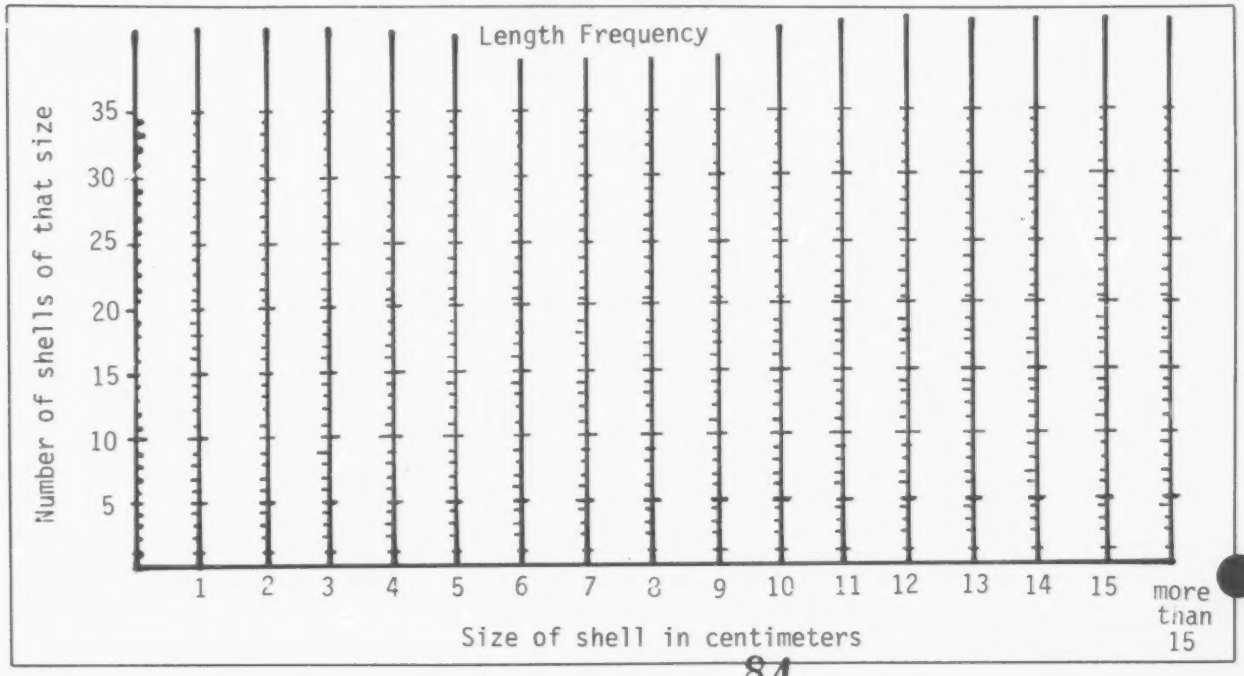
1. Divide students into groups of two or three. Ask members of each group to collect as many of one kind of shell as they can in 10 minutes. Pick shells that are plentiful. You may want to assign all groups the same shell, but in different sections of the beach; or assign each group a different kind of shell.

2. Using a ruler, measure each shell from the hinge to the edge opposite the hinge.

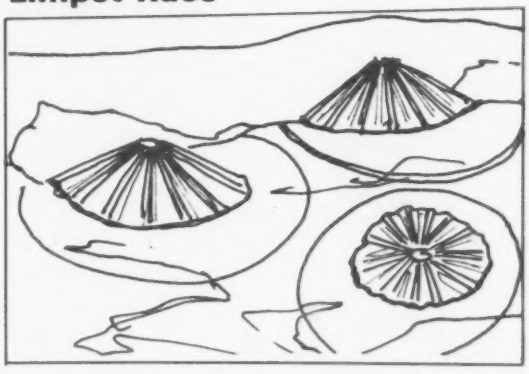
3. Plot the number of shells found in each length category (round measurements to the nearest centimeter). Use the following form.

4. What does this tell about death in the local mollusk population? What size is the most plentiful? Is there one size at which only a few were found? At which size do most of the mollusks die?

5. Return your shells to the beach, so others can enjoy them, too.



Activity 9
Limpet Race



To have fun while illustrating how limpets can move surprisingly fast, try this experiment:

Materials:

- live limpets
- chalk

Vocabulary:

- limpet
- foot
- radula
- mouth

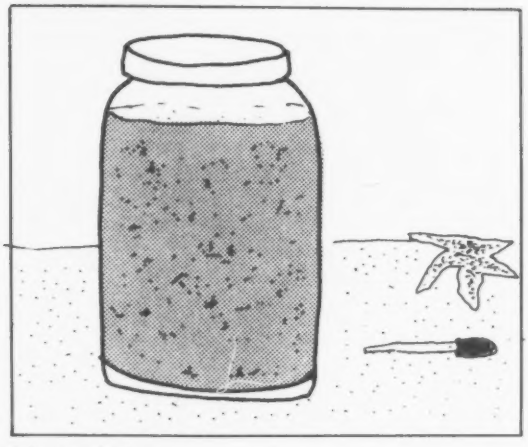
Procedure:

1. Catch a limpet. You'll have to sneak up on it because if you try to pull an alerted limpet from a rock, it can be difficult, and you might injure the animal. Examine the limpet, showing students the tiny, slit-like mouth on the underside of the soft animal. Explain how the limpet uses a radula to scrape algae from rocks.

2. Find an area in which limpets are common high in the intertidal zone. (One species lives on large rocks almost at the upper tide limit.) To hold the limpet race, divide the class into groups. Select a limpet for each group, and have students draw a circle around the limpet they have selected. Use a jar lid, tin can, paper plate or other guide to make all the circles the same size. Have the groups make a chalk mark on the limpet for later identification.

3. After an hour or so, return to the limpet area and check to see if the marked limpets have moved. You may want to calculate their rates of travel. Note the directions of travel, too. Many limpets feed at night and move to the undersides of rocks during the daytime, so some of the limpets may not have moved.

Activity 10
Plankton



Materials:

- plankton net
- baby food jars and lids
- binocular microscope - solid base on which to set the scope
- petri dishes (optional)
- eye dropper (optional)

Vocabulary:

- plankton

Procedure:

1. Find a site for plankton collection. Piers and docks are ideal. Drag your plankton net (see the field trip preparation section of this unit) horizontally through the water, back and forth the length of the dock. Or, walk it through the water, pull it behind a boat, or throw it out into the water from the beach and then pull it back in.

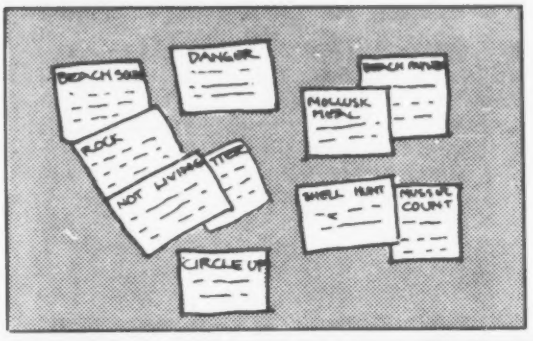
2. Wash the organisms caught in the nylon mesh into the baby food jar. Hold the jar up to the light and watch for movement to see if you have collected any plankton. If necessary, pull the net again until you get a good concentration of animals.

3. Remove and cap the jar. If you are taking a number of samples, you may want to label each jar for later comparison.

4. Catch some plankton with an eyedropper and--either in the field or later in the classroom--put them in a petri dish or on a slide under the microscope. The smaller the drop of water, the less room the creatures will have to escape the microscope's field of view.

5. Demonstrate the microscope. Focus on the plankton and let students look. Encourage them to search for modes of locomotion, count legs, and look for other body parts. Let them wonder at the life in a drop of water.

Activity 11
Beach Task Cards



The following activities can be prepared on task cards and distributed during the field trip, either all at once or as a change of pace between group activities. Students can do them individually or chaperones can lead small groups. Select the cards most applicable to your area.

BEACH SOUNDS

Find a spot away from other students where you can sit quietly.

Listen to the sounds around you for three minutes, and remember them to tell the group later.

What did those sounds make you think about?

How did the sounds make you feel?

DANGER

Pick a favorite spot on the beach.

Think about your spot. What kinds of plants and animals live there? Name as many as you can.

Think of any dangers these plants and animals will face because you are visiting the beach. In your beach book, list four of the dangers you think they will face.

BEACH MYSTERY

Find clues to a beach mystery. Explain the clues and tell a story about what happened. (Example clue: tracks in sand, feather on beach.)

PERIWINKLE SEARCH

Turn over a rock and gather all the periwinkle shells into a milk carton or margarine bowl. Be sure to turn the rock back over after you have finished collecting.

Count all the shells.

Do any of the shells have hermit crabs inside? Count them.

What will the hermit crab do when he gets too large for a periwinkle shell?

Carefully replace the animals and the rock so the animals will have a safe, damp home.

ROCK HOME

Turn over a rock in an area designated by your teacher. Draw at least two animals you find there.

Why do you think the animals prefer to live under a rock?

Are there any animals attached to the rock? How do you think they are attached?

If you lived under a rock, what would you need to do to be able to live there?

Are there any advantages for these animals to live under rocks, while they are out of the water at low tide?

Carefully replace the rock in its original position to return the home to normal.

NOT LIVING

List in your beach book at least five non-living materials at the field trip site.

Put a star by those that occur naturally. (In other words, those not there because of humans.)

Put a second star by the materials necessary for life to survive here.

MOLLUSK HABITAT

Pick one type of mollusk. How far up the beach is the farthest it lives? How close to the water does it live?

In your beach book, draw a picture of a mollusk in its home.

What animal lives the farthest away from the water?

What mollusk lives as far into the water as you can see?

LITTER

Collect litter. Put all your litter in one spot. What clues does it tell you about who has been here? Make a story based on the litter you find. Put the litter in a bag to throw away.

CIRCLE UP

Hold hands with a friend and make a circle. Find a spot on the beach where there are three different kinds of invertebrates inside your circle. Write their names in your beach book. Count how many of each kind there are, and write that number in your beach book.

MUSSEL COUNT

How many mussels can you cover with one hand? How many can you and a friend cover with all four hands?

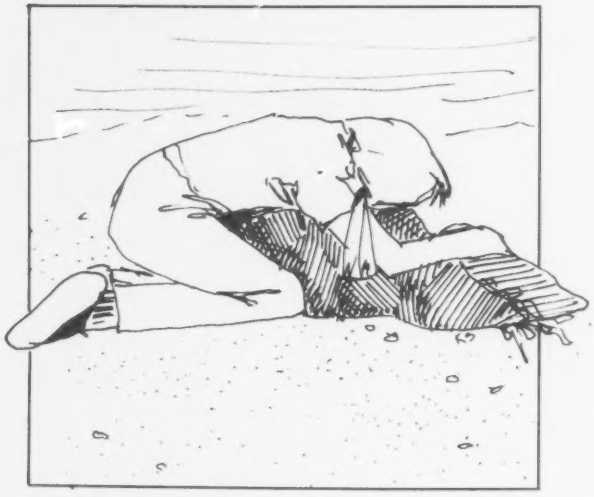
SHELL HUNT

Find the most colorful shell on the beach. Leave it where it is, but remember where it is. Find the littlest shell, the biggest shell and your favorite shell. Be careful not to step on them. Take your group on a tour to see them.

MOLLUSK MEAL

Find evidence of a mollusk meal. Who ate the mollusk? What kind of mollusk was eaten? What could eat the mollusk-eater?

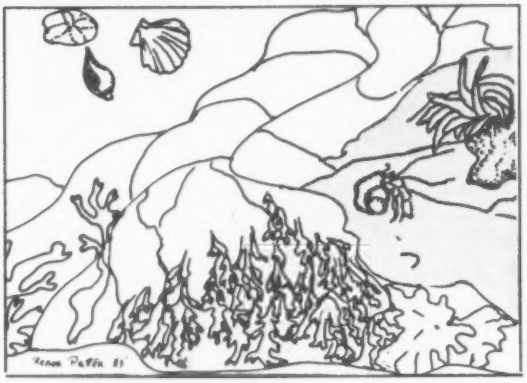
Activity 12
Pantomime



Procedure:

1. Provide the following scenarios for students to mime:
   - You are a chiton hanging onto a rock.
   - You are a hermit crab in a periwinkle shell on the beach.
   - You are a snail under water, feeding on grass.
   - You are a hermit crab looking for a shell. Then you find it.
   - You are an abalone on a rock and a person is trying to pry you loose.
   - You are a clam under the sand, and you've been stepped on.
   - You are a mussel feeding.
2. Ask students for suggestions of additional pantomimes for the class to try.
3. Encourage students to enlist the help of their friends if they think a pantomime requires more than one actor or actress.
4. Let each student or group of students do a pantomime and have the rest of the class guess what they are.

Activity 13
On-site Review



Procedure:

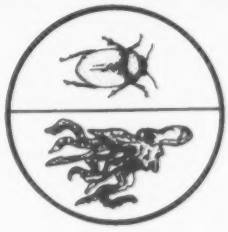
1. Bring the group together to share the day's experiences and learnings.

2. Ask students to volunteer something they saw or did today that they had never done before, or to explain something they learned.

3. Review some of the card tasks. What did students hear during their quiet period? How many mussels did they cover with one hand? (Tailor other questions to the tasks you selected.)

4. Discuss what kind of impact your visit had on the beach. Did you leave it in better or worse shape? What could you do to leave it better?

5. Close with sharing your favorite things about the beach or the field trip.



Unit Seven From Mollusks to Insects: Water Invertebrates

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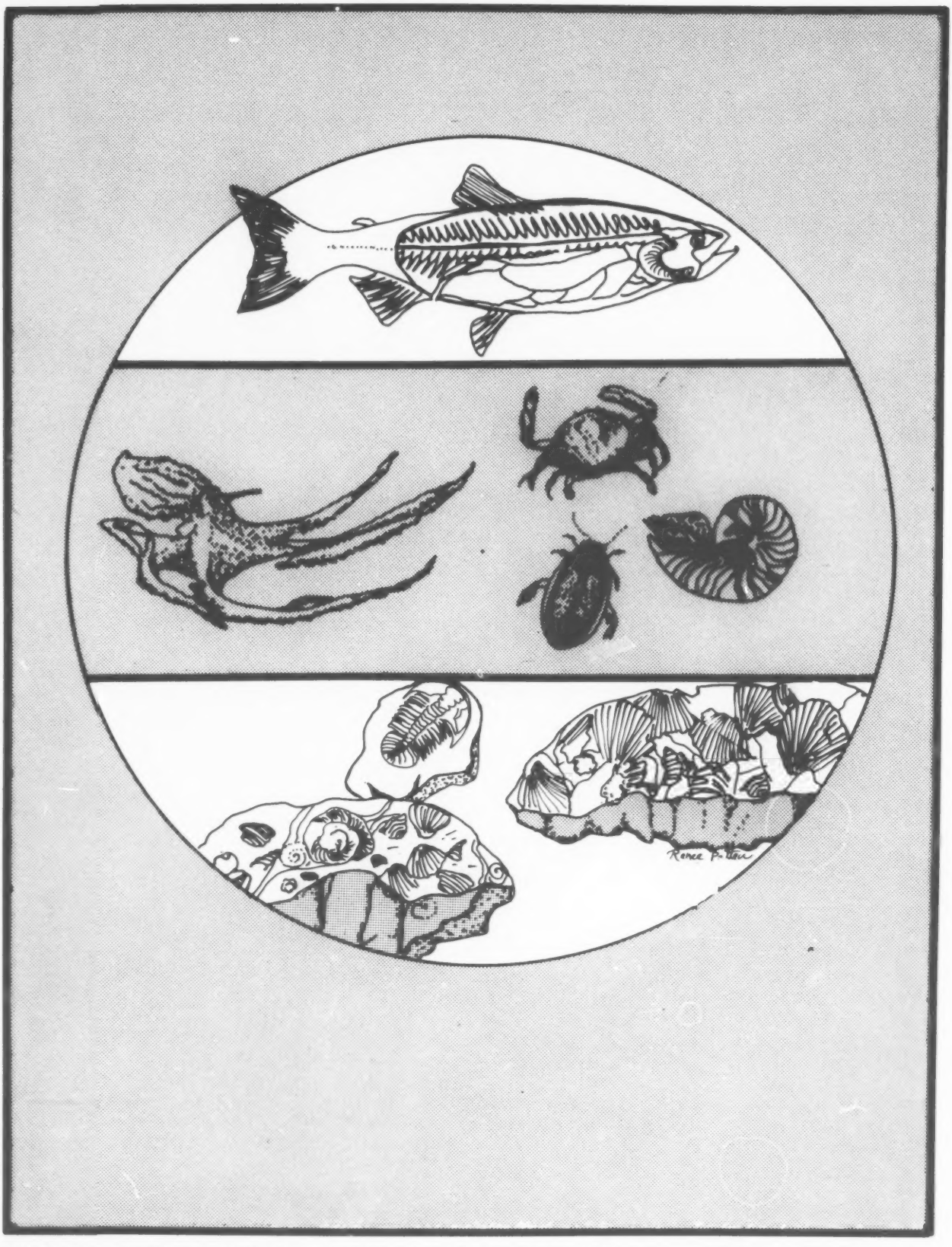
Objectives:

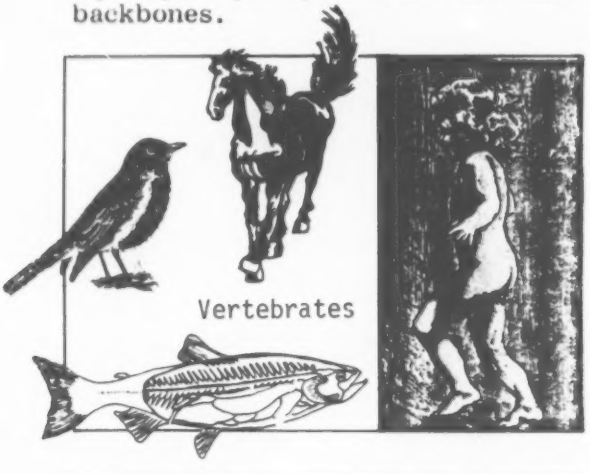
To enable students to:

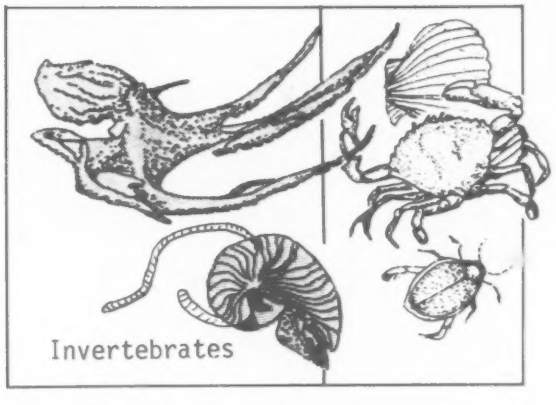
- Recognize that vertebrates are animals with backbones (Activity 1).
- Recognize that invertebrates are animals that lack backbones (Activity 1).
- Designate animals as vertebrates or invertebrates (Activities 1, 2).
- List ways to show respect for invertebrates as living things (Activity 1).
- List similarities and differences between invertebrates and vertebrates (Activity 2).
- Explain that the earth changes with time (Activity 3).
- Define a fossil as a preserved record of a living thing (Activity 3).
- List factors that lead to the extinction of organisms (Activity 3).
- Simulate the process of shell breakdown on the beach (Activity 4).
- List the processes of decay (Activity 4).
- Simulate the creation of a shell fossil (Activity 5).



Unit Seven: From Mollusks to Insects: Water Invertebrates. Insects and mollusks are easily studied representatives of invertebrates, which are the most numerous, as well as very ancient, group of animals.

People are "vertebrates," as are most of the animals with which people most often deal: dogs, cats, horses, birds, fish. But vertebrates make up only a very small part of the whole--about 5 percent. Ninety-five percent of the animals on earth are "invertebrates"--those often wiggly, squishy, squirmy animals that lack backbones.





Our backbone (along with other bones) supports us and provides anchorage for muscle attachment. Invertebrates use different strategies to provide the same function. Many--such as mollusks, crustaceans and insects--have evolved a hard outer covering: a shell. Others, such as the octopus, depend on the buoyant quality of water to support their shapes.

The mollusks and insects are two subgroups within the large invertebrate category. Mollusks (Mollusca) constitute a phylum of soft-bodied, usually shell-covered organisms found mainly in aquatic environments. The insects (Insecta) and crustaceans (Crustacea) are classes of the phylum Arthropoda, which also includes spiders. The insects make up a wide and successful class that is primarily terrestrial but has invaded many freshwater environments. The crustaceans include crabs and shrimp in the marine environment, crayfish and zooplankton in freshwater, and the homely pillbug on land.

Students can easily discover their own backbones and other bones. They also will recognize that vertebrates usually are familiar animals with heads, eyes and bodies. Invertebrates, on the other hand, not only lack bones, but many of them--headless and eyeless--don't look like "animals" at all.

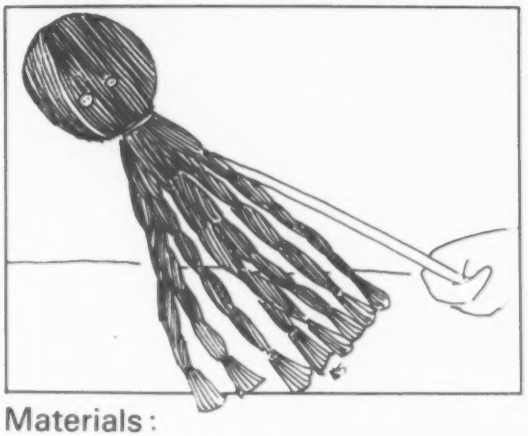
Both insects and mollusks are abundant organisms. The insect class is the single largest group of animals, larger than all other groups combined, with more different kinds of individuals than any other group. Mollusk is the second largest phylum. (Arthopods is the largest, as it includes the insects. Both groups are ancient) The mineral shell of the mollusks makes it particularly likely to show up in the fossil record.

The earliest mollusks lived in the Precambrian oceans more than 600 million years ago. Univalves and bivalves became abundant in Ordovician oceans about 420 million years ago. In the Devonian period a few hundred million

years later, some bivalves took up residence in fresh water. About 100 million years after that, univalves also entered fresh water. In recent times, the trend has been that freshwater mollusks are evolving and increasing, while saltwater species appear to be decreasing.

The first flying animals were insects. Huge cockroaches and dragonfly-like creatures with six-foot wing spans prowled the shores of oceans and ponds 200 million years ago. Aquatic insects were terrestrial before invading both salt and fresh water--though they did so in relatively small numbers. The main challenge of submergence for these otherwise omnipresent organisms is breathing, as their traditional spiracle method is not easily adaptable to water.

Activity 1
'Spineless' the Octopus



Materials:

- yarn
- glue
- scissors
- nylon stockings or styrofoam ball
- buttons
- 12-inch stick
- worksheet:
  ...Invertebrates (7A)

Vocabulary:

- vertebrate
- invertebrate
- backbone
- "in" (meaning "not")

Procedure:

1. Make a "Spineless the Octopus" puppet: Cut a skein of yarn into two-foot pieces. Tie these strips together and drape them around a styrofoam ball or a ball of nylon hose the size of your fist, covering all sides evenly. Tie the yarn into eight even sections and braid each of these to form the eight legs of the octopus. Insert the stick to provide a handle. Glue on buttons for eyes.

2. Introduce "Spineless" to your class. See who recognizes what she is. What do they know about Spineless?

3. Ask the class to tell you some similarities and differences between themselves and Spineless (leading up to the major difference: kids have backbones and Spineless does not).

4. Have students locate their own backbones. Explain that the presence of their backbones and other bones includes them in a group of animals called vertebrates.

5. Write "vertebrate" on the blackboard. Ask students to give examples of other animals they know that have bones. Try to elicit a diverse array of groups. If they have not listed fish, remind them of the bones found in fish when they are eaten or cleaned. Chicken or duck bones can provide similar links with the bird world.

6. Now ask the class for examples of animals that lack backbones. Draw on student experiences with aquatic animals in the Sea Week Discovery volume, such as insects, sea stars, anemones, worms, and such mollusks as clams, snails and the octopus. Explain that these are called invertebrates.

7. Explore with students how these invertebrates are animals, even though they lack the bones of dogs, whales or birds. Invertebrates, like all living things, should be respected and cared for to preserve their lives. Ask the class to think of ways to act so as to be sure not to hurt invertebrates.

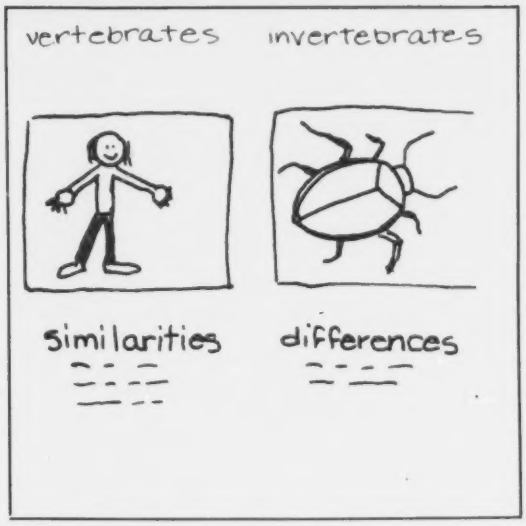
8. Write the word "invertebrate" on the board. Compare the words "vertebrate" and "invertebrate." Explain that the prefix "in" means "not." For example, inexpensive means "not expensive." Can the students think of any "in" words that mean "not"? Examples:

inaccurate	independent
inactive	indirect
inadequate	inedible
inattentive	infrequent
incapable	inhospitable
inconvenient	inhuman
incomplete	insane
incomparable	insincere
incorrect	invalid
incredible	invisible

List some "in" words on the board. You could use these and other Sea Week words as spelling words.

9. Give students the Invertebrates worksheet and have them color and circle all of the invertebrates and place an "X" on all the vertebrates.

Activity 2
Similarities and Differences



Materials:

- octopus puppet
- pencils
- crayons
- invertebrate specimens or pictures
- worksheet: ...Similarities and Differences (7B)

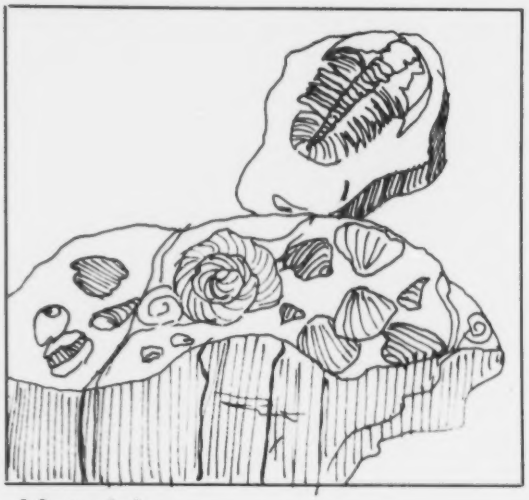
Vocabulary:

- similarities
- differences
- invertebrate
- vertebrate

Procedure:

1. Have students select partners. Give the pairs a Similarities and Differences worksheet.
2. Have each pair choose an invertebrate specimen or picture. Have one youngster draw a picture of a person in the vertebrate box, while the partner draws the selected invertebrate.
3. Ask students to list vertebrate-invertebrate similarities in one column, and differences in another. Review the observations as a class.
4. Discuss with students the purposes of their own bones. Explain that without bones, each student would be a limp pile of flesh. Ask students: if the insects and crustaceans and mollusks don't have bones, then what offers them support and gives them something to which their muscles can attach? (Their hard outer coverings--or skins or shells; or, for shell-less invertebrates, the buoyancy of the water.)
5. Return to Spineless. Have Spineless explain to the class that there is a whole world of spineless invertebrates in oceans, ponds and streams--and that actually most animals are invertebrates. The students, as vertebrates, are rather unusual. Spineless also thinks that she and the rest of the invertebrates are rather important. And because the teacher shares that opinion, the class is going to spend (Sea Week) learning about invertebrates of oceans, streams and ponds.

Activity 3
Change



Materials:

- fossil examples or pictures
- worksheet:
  ...Fossils (7C)

Vocabulary:

- change
- fossils
- extinct

Procedure:

1. Explain that, at one time, there were animals living here that are not here today. Discuss what could have caused the animals to disappear. (lack of food, lack of home)

2. Talk more about change through time, and explain that areas change, too. There are pla es even within students' lifetimes that used to have trees or plants, or buildings that have burned or have been demolished. Ask for other examples. Has a nearby river or stream changed course, or have ponds appeared or disappeared, beaches receded or advanced?

3. Explain that, long before humans arrived, some places in Alaska were once covered by ocean water. When this ocean existed, animals with shells lived here.

   A fossil is a record of a living thing preserved over time. Many fossils are animals that are now extinct. Change of habitat is one thing that causes animals to become extinct. Could the fossil mollusks in the Brooks Range survive as living animals now? Could the moose that used to wander the banks of the Chena River survive in downtown Fairbanks today?

5. What could make animals in our area go extinct? What can students do to help protect these animals?

Activity 4
Mollusk Fossils

Background:

Invertebrate fossils date back to the earliest traces of life on earth. Most fossils in Alaska are found in sedimentary rock. Mollusks have the best chance of showing up in the fossil record because they are numerous, they have hard parts, and they live in a region of low oxidation where there is a chance of burial. Usually the hard parts of organisms are preserved; notable exceptions are mammoths frozen in Alaska's permafrost or organisms buried deep in peat bogs. Most organisms do not become fossilized because they disappear due to decay, scavenging animals, chemical action or physical wearing away (as of shells rolling in the surf).

Fossils are found throughout most of Alaska. Geologists in your area may be able to tell your class the local geologic history. Trips to fossil sites should be arranged with conservation of the fossil record as a primary objective.

Materials:

- shovel
- garbage
- sand
- shells
- microscope or hand lens
- hammer or mortar and pestel

Vocabulary:

- decay
- fossil
- sand
- wear

1. Visit your community dump or someone's compost heap. Talk about what is happening (or will happen) to the garbage. It rots, or decays, if the weather is warm enough. As an additional or alternate project, bury some lunch leftovers in the school grounds. Mark your spot and return weekly to keep a record of the decay process.

2. List what could happen to something dead. It could decay, be eaten by animals, wear away by wind or sand action, dissolve, or become a fossil.

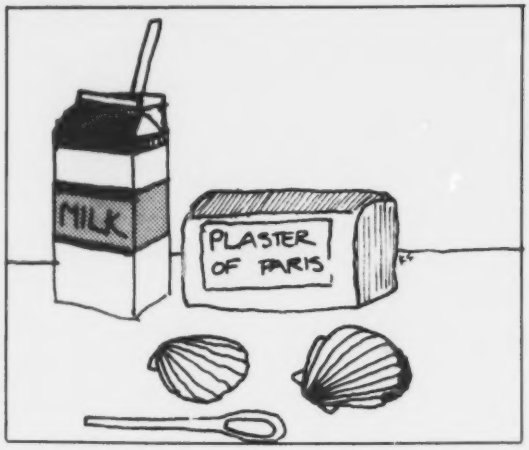
3. As a class, discuss your mollusk shells. What happened to the animal once inside? Why are some of the shells broken? What could happen if they were left on the beach?

4. Carefully crush your shells with a hammer or a mortar and pestle, explaining to students that you are hurrying the process that might happen on the beach. Examine the crushed pieces with either hand lenses or a microscope.

5. Now magnify some sand to see if you can find shell pieces in the sand.

6. Explain to students that to become a fossil, a shell has to stay around long enough to be buried in mud or dirt that will later be made into rock by being compressed.

Activity 5
Make a Fossil



Background:

There are a variety of processes of fossilization. Insects enclosed in amber and mammoths frozen in the tundra are examples of the rare case of actual preservation of the original organism. Molecular replacement of the original material by a variety of minerals is more common. In other instances, the original substance is altered during fossilization. Commonly, rather than finding the original shell, one finds the imprint, mold, or cast of the shell.

When a shell is buried in sediments, it can leave the imprint of the external design of the shell on the surrounding material. This imprintation is called an external mold of the shell. If a shell becomes filled with sediment, the internal structure of the shell can be impressed, and an internal mold results. Often, water percolating through the sediments dissolves the original, leaving only the shell mold. Sometimes a mineral will fill the space left by the dissolved shell. The mold then creates a cast of the original shell.

Materials:

- plaster of Paris (if unavailable, substitute building plaster, soft mud or modeling clay)
- bivalve shells (two valves)
- sticks
- water
- petroleum jelly (optional)

Vocabulary:

- bury
- burial
- time
- fossil
- mold
- internal
- external

Procedure:

1. Mix the plaster of Paris with water in a milk carton, using a stick to stir. At the right consistency, the plaster should flow slowly, but not be runny.

2. Explain to students that you are going to simulate one method of making a fossil. Review the concepts of burial on the ocean bottom, as well as preservation over time.

3. Fill the two shells with plaster of Paris. Allow to harden. Discuss with students what might have covered the shell or the ocean bottom.

4. When the plaster is hard, remove it from the shell. It should show all the markings of the inside of the shell, such as the muscle scars.

5. Fill the bottom of a halved milk carton with plaster of Paris. Press the concave sides of the shells into the

plaster and allow to harden. Remove the bivalve to reveal an external mold.

6. Use the internal and external molds to cast plaster shells. Coat them with petroleum jelly to prevent sticking.

Additional Activity:

Use plaster of Paris and shells to mold plaques for gifts.

Unit Eight
Freshwater Insects

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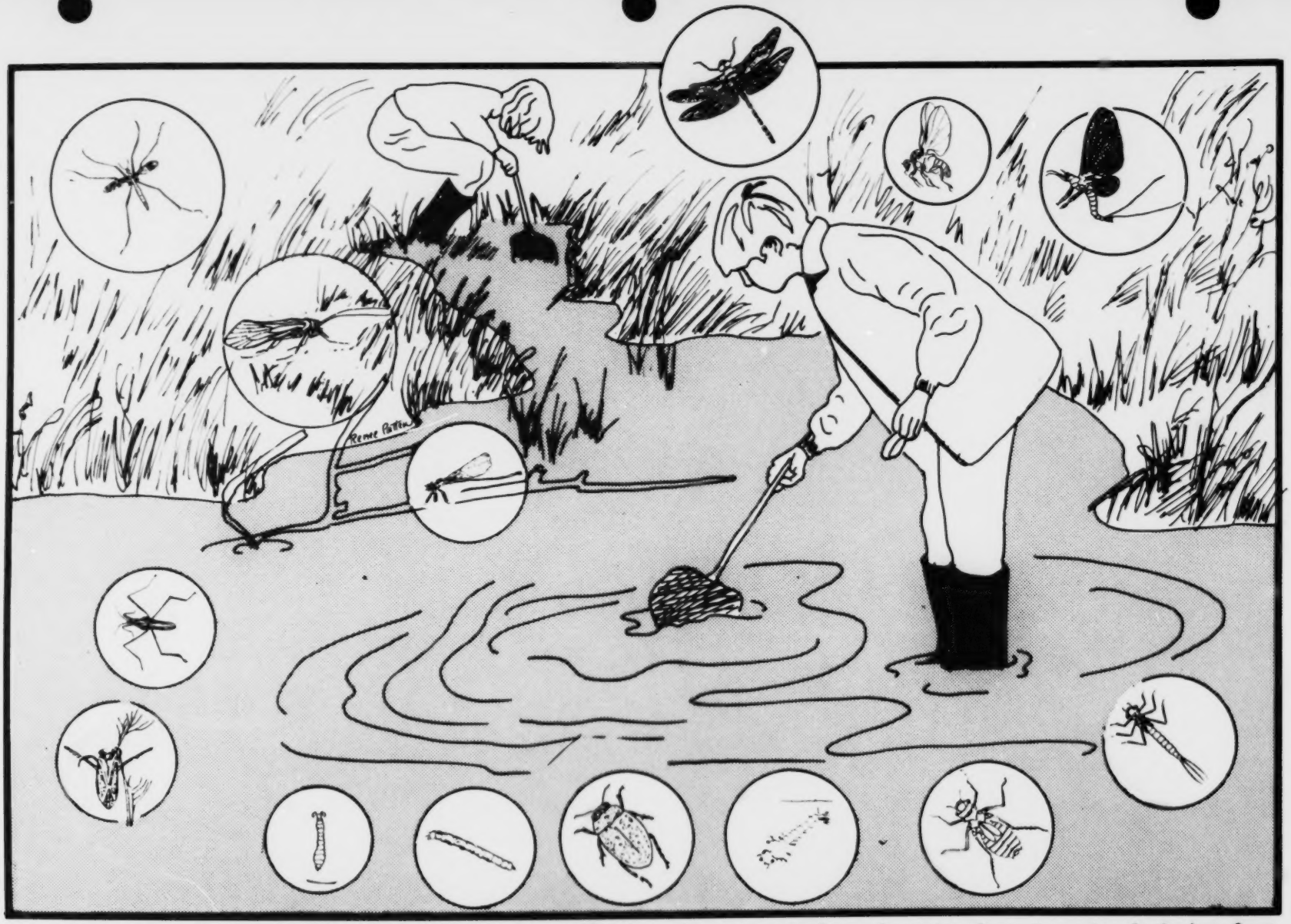
Objectives:

To help students:

- Recognize the distinguishing characteristics of insects (Activity 1).
- Compare insect types most commonly found in Alaska waters (Activities 2, 3, 4, 5, 6, 7, 8, 9).
- Recognize the major stages of complete and incomplete metamorphosis, while distinguishing between these two processes (Activities 2, 3).
- Use legends, poems and art to interpret insect phenomena (Activity 4).
- Illustrate adaptation by creating an adapted water insect (Activity 5).
- Separate insects' food preferences: eating other animals, eating plants, eating plankton (Activities 5, 6).
- Define habitat and list three habitat requirements (Activity 7).
- Understand the importance of protecting animal habitats (Activity 7).
- Describe an organism's habitat: orally, graphically, and with pantomime (Activity 7).
- Compare caddis-fly cases to students' own homes (Activity 8).



Unit Eight: Freshwater Insects found in Alaska wetlands, streams, ponds and estuaries: (counterclockwise from bottom left) caddis-fly larvae, midge larva, predacious diving beetle, mosquito larva, dragonfly nymph, damselfly nymph, mayfly, black fly, dragonfly, black-fly larvae, damsel fly, caddis fly, midge, water strider, water boat-man.

Fresh waters contain many of the same invertebrate phylums found in the sea. Crustaceans, worms, sponges--even jellyfish and mollusks--can be found in Alaska ponds, streams, lakes and rivers. Students were introduced to the major groups of invertebrates with Discovery, the first volume in the Sea Week Curriculum Series. This unit continues to build on that foundation.

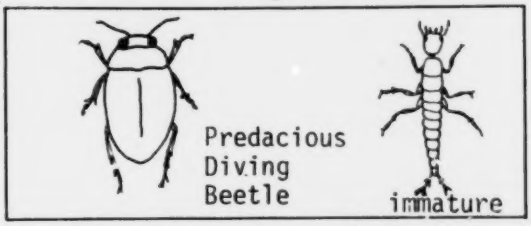
The class "Insecta" is included in the large phylum "Anthropoda," which comprises the invertebrates with jointed legs and a segmented body. Insects embody the largest and most abounding group of animals in the world. In fact, Insecta is larger than all other animal groups combined. It evolved first as a terrestrial group, then migrated into fresh water. But nevertheless, few insects have managed to invade the saltwater environment.

Students in Southeast Alaska will be able to find about 30 different families of insects. Farther north though, the diversity diminishes, to the point where only about four different families are found on Arctic Alaska's North Slope.

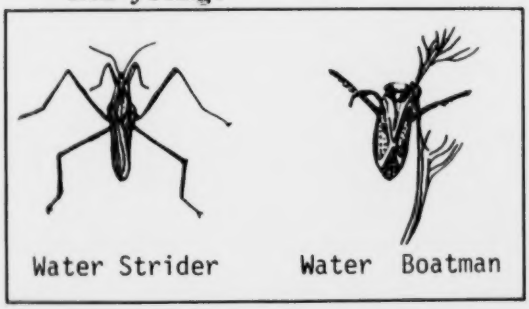
The adult insect is covered by a hard shell and has three body parts: head, thorax and abdomen. Its wings as well as its six-jointed legs are attached to the thorax. Alaska's freshwater wetlands are rife with both immature and adult insects. The immatures may be in the form of nymphs, larvae or pupae, and thus are far more variable than their adult counterparts.

The Insecta class includes the following orders common in Alaska fresh water:

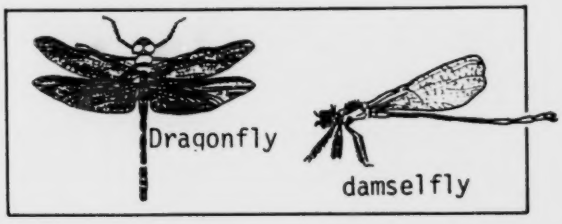
Beetles (Coleoptera) live in the water as both adults and young. (An adult predacious diving beetle is able to attack and eat a tadpole.)



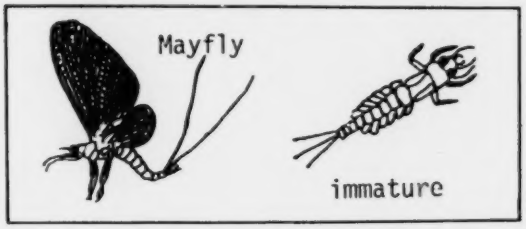
"True" bugs (Hemiptera), such as the water strider and water boatman, for the most part eat by sucking the juices of their prey through a hollow beak or mouth parts or probiscus. They live in or on the water both as adults and young.



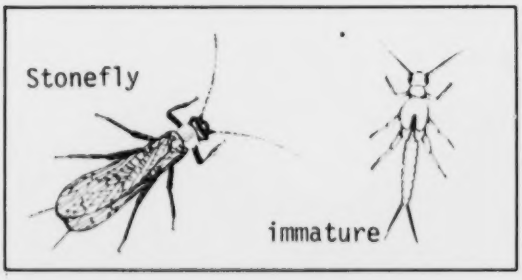
Dragonflies and damselflies (Odonata) spend the winters as immature insects underwater. In summer, they become graceful fliers that can be spotted over most ponds and wetlands in Alaska.



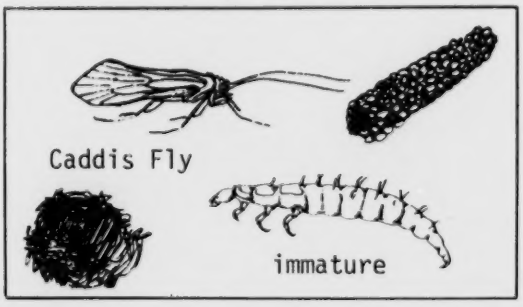
Mayflies (Ephemeroptera) are well-known to sport fishermen along our rivers and streams, who imitate these insects with "dry flies." Mayflies rise in great masses, which sometimes resemble small clouds over the water.



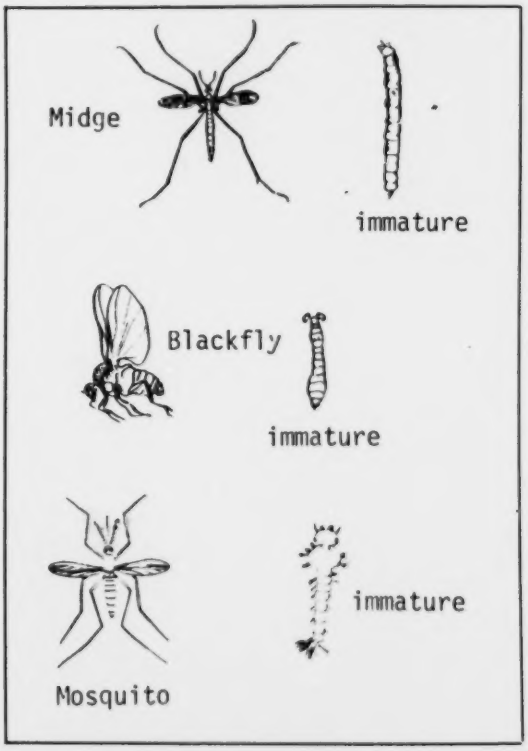
Stoneflies (Plecoptera) are ancient relatives of the cockroach. Students, teachers or others who think they have come across "flies," either lodged in the snow or emerging from the water during early spring or even winter, have actually found stoneflies.



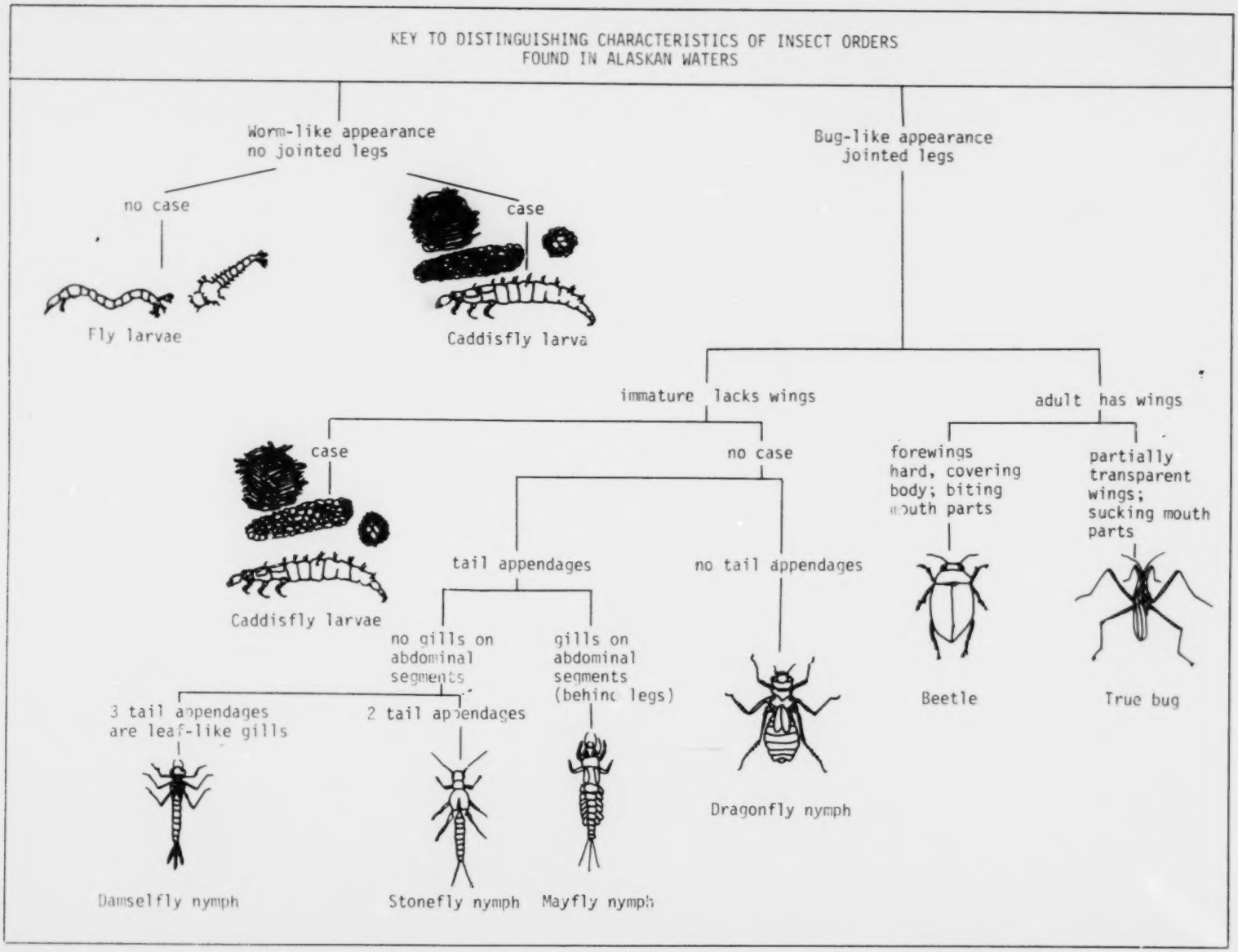
Caddis flies (Tricoptera) are insects that fly as adults, but can be found on stream or pond bottoms while young, with their attached "homes" of pebbles or vegetation.



Flies (Diptera) include such insects as black flies, midges and mosquitoes. Though the bane of most Alaskans, they also provide a plentiful study resource for the classroom.



The following chart delineates insect groups by key distinguishing characteristics. These major taxonomic groups, the insect orders, are detailed in the organization of each order, with reference to distinguishing characteristics, life habits, food sources, collecting techniques and aquarium needs. Your students, of course, do not need to know all this information to meet unit objectives. It is provided here for teachers to become more familiar with the major aquatic orders in Alaska, and also to help identify insects in the field. Once you know what an animal is, you can use it for classroom experiments recommended in the final unit of this guide.



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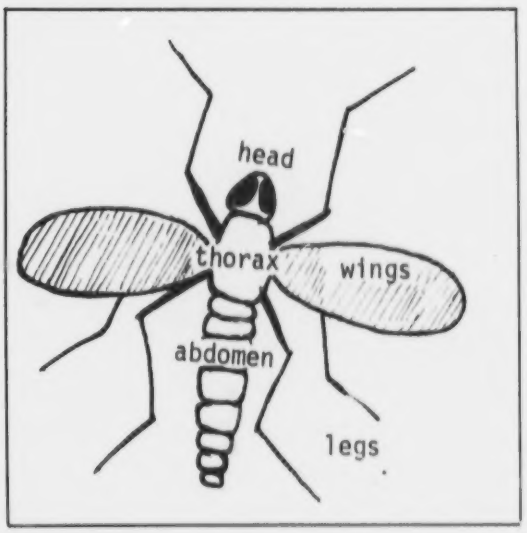
Activity 1
Wiggle, Squiggle - Name That Bug



Materials:

- insect pictures
- insect specimens
- paper
- crayons
- scissors
- glue or tape
- worksheet: ...Insect Parts (8A)

Vocabulary:

- legs
- wings
- thorax
- abdomen
- head

Procedure:

1. Pass out the insect specimens or display the pictures. Ask students to describe what they see: number of legs (6), wings (usually 4, sometimes 2), location of the head and tail end of their insect, color, texture, shape.

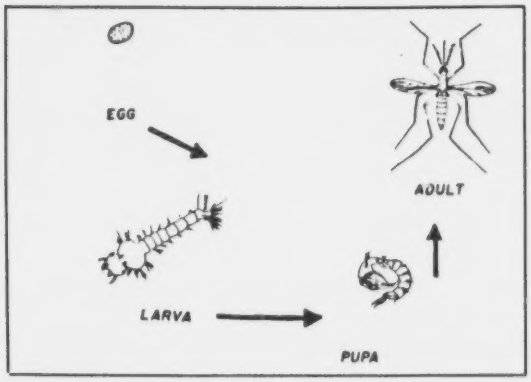
2. Divide students into groups of four. Do not have the students sit together yet. Introduce the insect parts and assign one student in each group a different part(s) of the insect: 1) head, 2) wings, 3) thorax with legs attached, 4) abdomen. Have students draw their sections of the insect using one of the pictures or specimens as models.

3. When finished, have students join the rest of their group. Students cut out their own section of the insect and then the group "builds" the insect, pasting it together on another piece of paper.

4. When the insects are assembled, students can name their creations. Scientists name organisms by what they look like, how they live, or after either themselves or famous scientists.

5. Use the Insect Parts worksheet for review.

Activity 2
Flies -
Complete Metamorphosis



Background:

Flies (Diptera: di, two; ptera, wing. All flies have only two wings.) Perhaps the most maligned of all insect groups, "Diptera" includes such varying forms as the mosquito, midge, housefly, deerfly, black fly, gnat and crane fly. The farther north one travels, the greater proportion of all insects will be represented by flies. Therefore, students will probably turn up a great number of flies in their explorations.

Adult flies have large, compound eyes, as well as mouth parts adapted for piercing, sucking and licking. Though the adults are not aquatic, many pupa and larva forms are. The immature are more variable than the other groups discussed, but the aquatic ones all look worm-like, with soft bodies and no true legs or eyes. Most pupae are inactive, but mosquito and midge pupae move with fast, squirming, wriggling motions. The pupae typically have fused appendages. The larval stage lasts only a week in some mosquitoes, midges and black flies, and up to a year or more in some crane flies.

Crane flies or Tipulidae adults look like overgrown mosquitoes. The larvae are fat worms distinguished by a fat tube at the rear end. Most shred leaves for food. They are found in a variety of habitats.

The wormiest of the worm-like larvae are the midge, or Chironomidae larvae. They are slender and soft-bodied, and generally have a short, stubby leg behind the head, with a similar leg at the tail end. Any Alaska pond you explore will produce midge larvae. Most will be found in the bottom, sometimes in silky cases. There are more different midges than any other organism in Alaska. Some eat dead leaves, some filter feed, and others graze. The adult midge resembles a mosquito, though it doesn't suck blood (though some do bite).

Insects change. The young or immature organisms differ, in varying degrees, from the adults, and do not possess all the distinguishing characteristics of insects. Students will discover both adults and immatures in Alaska waters. The metamorphosis, or change process, has two basic patterns. Some insects, such as the familiar butterfly and all these "true" flies, have young that vary drastically from the adult form, and change from one form to the other through a pupa stage. Other insects, such as the stonefly and water strider, are not dissimilar to the adult, and change gradually through stages (instars) through their lives. The dramatic change process of the butterfly is called "complete" metamorphosis. The gradual change process of the dragonfly is called "gradual" metamorphosis. Because insects possess a hard external skeleton, they must shed their skin (molt) when they grow or pass from one instar to the next.

During complete metamorphosis, the adult female lays the egg. The egg then hatches to produce an active larva, usually a worm-like organism (caterpillar). Then the larva changes into a wingless, mouthless, usually dormant pupa (sometimes cocoon or crysalis), which metamorphoses into the winged adult.

Materials:

- pictures of insects--both adult and immatures
- insect specimens
- shed skins of insects
- construction paper, newspaper
- midge larvae
- picture of midge adult
- worksheets:
  ...Insect Life Cycle (8B)
  ...Midge (8C)

Vocabulary:

- change
- growth
- midge
- larva
- pupa
- eggs
- adult
- complete metamorphosis

Procedure:

1. Introduce the change concept to students. Discuss the growth of familiar organisms: spruce cones to spruce trees, puppies to dogs. You may want to have students bring in their own baby pictures. (Bring in yours!)

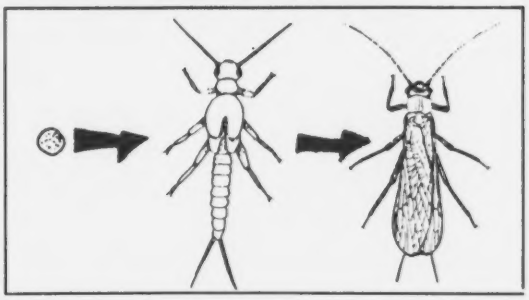
2. Point out to students that as we grow, our bones grow, and our skin grows to accommodate our new size. Point out that when people get fat, their skin does not pop, it stretches. Not so with insects. The insect's outer skin is its shell. Unlike the mollusk, it cannot change size.

   Make a stuffed insect for demonstration purposes, following the directions for stuffed bivalve given in Unit Two, Activity 2. Explain that the insect is going to grow on the inside. Have students help you stuff more and more newspaper into your insect. Eventually the seams of your insect will pop, and that is just what happens to insects and crustaceans. When their skin pops, they crawl out of it and a new skin hardens, which they eventually climb out of as well.

3. Using the moth, cocoon and caterpiller as examples, explain that some insects change from worm-like animals to ones with wings, by going through a magical period when they hide as a pupa. Show students the midge larvae and explain that they too will someday fly away. To illustrate this change, play a game. Divide the class into two teams and form relay lines. Place two sleeping bags at the far end of the room from the teams. Give the leader of each team a pretty costume (printed shirt). The leader runs to the sleeping bag, crawls in, puts on the costume and emerges (imitating the complete metamorphosis of an insect). The leader runs back to his/her line, takes off the costume, and gives it to the next person in line, who then runs down to the sleeping bag, and so forth until the line is complete.

4. Use the Insect Life Cycle and Midge worksheets to review the stages of complete metamorphosis with students.

Activity 3
Stoneflies: Gradual Metamorphosis



Background:

Stoneflies (Plecoptera: pleco, folded; ptera, wing. Stonefly wings are folded and held flat against the back when the insect is not flying.)

When observed resting at the water's edge, terrestrial adult stoneflies may be slightly reminiscent of cockroaches, with wings folded neatly over their backs. Found under the rocks of stream bottoms, the immature nymph provides the origin of the common name. They are an important food source for stream fish. These animals are restricted to highly oxygenated waters, and as such are found throughout the world only in the cleanest water, where a fast current or wave action mixes air into the streamflow. Because cold water holds more oxygen, some of Alaska's Arctic ponds are able to support stonefly nymphs.

All stonefly nymphs look similar to each other. While they range from one-fourth inch to three-and-a-half inches long, they all have elongated, streamlined bodies, two long antennae, filamentous gills on the thorax, and two long filaments on the tip of the abdomen.

Arctic region insects are usually smaller than insects of the same order from more southerly climates. As a result, most Alaska stonefly nymphs and adults are less than an inch long.

Stonefly feeding habits vary. Some are predators and others shred leaves dropped into water by streamside vegetation. The lively, active predators generally have bright, amber patterns on their backs. The more sluggish herbivores are a dull, uniform brown or black. The nymphs remain in their water homes from one to four years. The immatures crawl out of the water sometime in late fall to early spring, to shed their skins and emerge as winged adults.

The nymphs occur either in debris or under stones, and typically are in running water or on the edge of wave-swept lakes. They may be collected by handpicking them from the bottoms of stones--being careful to replace the stone after removal--or by picking through leaf debris in a light-colored dishpan. Nymphs also may be collected by placing a sieve or screen downstream of rocks agitated in your search.

The nymphs will survive only in a cold, well-aerated aquarium. In keeping predacious stoneflies, it is important for the health of the rest of your aquarium to keep them well-fed. An ample supply of leaf debris is important to the vegetarian stoneflies.

In the stonefly's metamorphosis, the egg hatches into an early stage (instar) nymph (the terms "naiad" and "larva" are also used). This nymph possesses jointed legs and an insect-like appearance. When the nymph grows, it loses its skin. Each stage differs from the earlier stage and resembles the adults more closely. A stonefly may go through several dozen instars before emerging as an adult. A late instar nymph has developed wing pads. The nymph crawls from the water onto a twig or rock for its final molt into the adult form, which of course, is winged.

The study of metamorphosis, which was introduced with the midge, can be continued with the stonefly.

Materials:

- pictures of stoneflies
- stonefly specimens
- worksheets:
  ...Insect Life Cycle (8B)
  ...Metamorphosis Squares (8D)

Vocabulary:

- stonefly
- nymph
- change
- adult
- egg
- similarities
- differences
- gradual metamorphosis

Procedure:

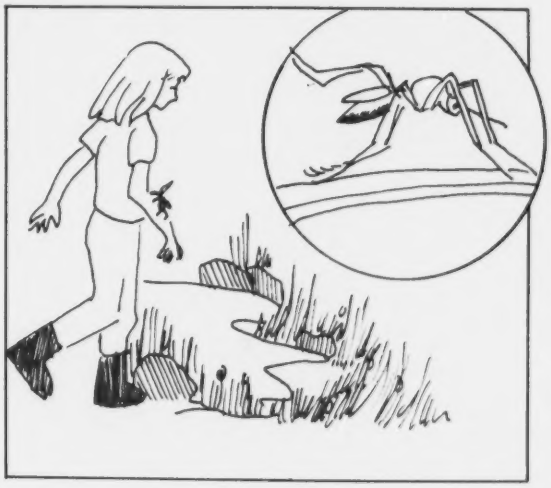
1. Using pictures or specimens of stoneflies, ask students if they have ever seen one either in the water or on land. Point out that the adults sometimes can be found in the snow around streams. These insects change form between youth and adulthood just as the midge and butterfly do, but not so dramatically. The stonefly young are called nymphs, whose gradual changes are more similar to

our own. The "baby" stonefly resembles the adult. Have students list similarities and differences between adult and nymph from the pictures, worksheets or specimens.

2. Use the Insect Life Cycle worksheet to contrast and compare complete metamorphosis.

3. Pass out the Metamorphosis Squares worksheet to students working in pairs or individually. First cut up the sheet, then order them, using the Insect Life Cycle worksheet as a key.

Activity 4
Mosquitoes in Alaska Native Lore



Background:

The most notorious fly on this planet is undoubtedly the mosquito (Culicidae). Even young students are mosquito experts, familiar with their habits.

Mosquito larvae live in practically any still water, making it a hardy aquarium specimen. This larva is different from the larvae of other flies because of its enlarged, fused, thoracic segment. This "wriggler" floats at the surface, breathing through a snorkle at the tip of its abdomen. It squirms downward if disturbed. As is true of most diptera, mosquito larvae generally are filter feeders.

Many adult mosquito females require a blood meal before they can lay their eggs. Males feed on vegetable juices.

The non-biting phantom midge is in the same family as the mosquito and resembles it in appearance.

Materials:

- "A Hunter's Memory" by Ivalvardjuk
- mosquito illustrations
- Tlingit mosquito legend by Shanon Gallant, pg. 109
- pencils/crayons
- paper
- worksheet: ...Mosquito (8E)

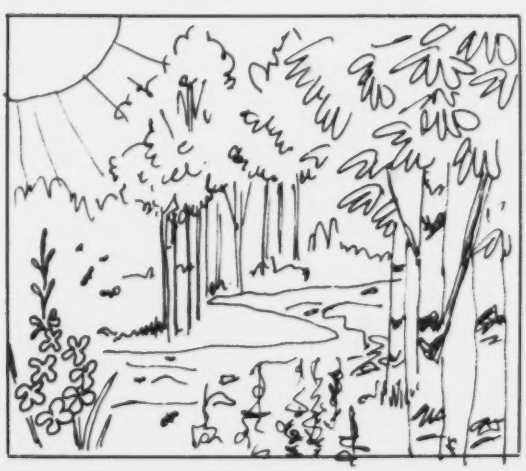
Vocabulary:

- seasons
- memories
- senses
- mosquito
- fly
- legend

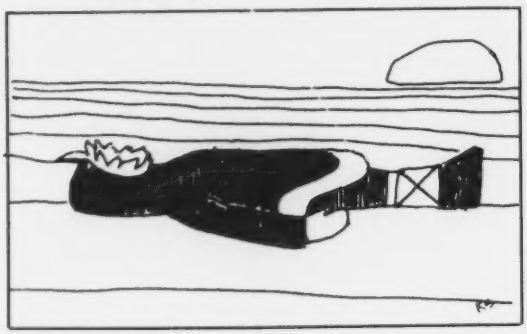
Procedure:

1. Discuss with students how each season creates different memories of sights, smells, tastes, touches and sounds.

2. Write "summer" on the board. Beneath it, make columns for sights, smells, tastes, touchings, sounds. Ask the first student to contribute a one-word summer sight, the second student a one-word summer smell, and so on until all students have contributed.



3. Read or have one of your children read orally "A Hunter's Memory." Discuss this Eskimo's memories of the seasons.



A HUNTING MEMORY

by
Ivalvardjuk

Cold and mosquitoes
are torments
that never come together.
I lie down on the ice,
I lie down on the ice and snow
So my jaws chatter
This I!
Aja-aja-ja

Is it memories
of the seasons
of the seasons
(mosquitoes swarming)
of the seasons
(ice paralyzing)
make the mind swoon,
as I stretch my limbs out
on the ice?
This is I!
Aja-aja-ja

(from Eskimo Poems from Canada and Greenland, translated by Tom Lowenstein, University of Pittsburgh Press, 1973)

If your students did not include "buzz" or "swat" among their board list of summer senses, add those to the list now.

4. Introduce the mosquito and its biology. Using the Mosquito worksheet, ask how many wings the mosquito has. Two-winged insects are in the true fly group. Tell your students that the word mosquito is Spanish for "little fly."

5. Have students complete the worksheet. (The worksheet arrows point to distinguishing characteristics of the mosquito larvae.)

6. Ask students why they think Alaska has so many mosquitoes. After discussing their hypotheses, tell students that everyone is going to learn how the Tlingits explained the abundance of mosquitoes. Read to students the Tlingit mosquit legend by Shanon Gallant, which is the illustrated story located at the end of this unit, page 109. Stop after part four and ask the class to predict what they think will happen. Complete the story and compare the legend to their original hypotheses and predictions.

7. Have students draw pictures to illustrate the legend or to illustrate their earlier hypotheses.

8. Follow-up: Ask students, to write or illustrate stories explaining other freshwater insect phenomena. Examples:

Why mosquitoes bite people.
Why mosquitoes and people are enemies.
Why caddis flies build cases.
Why many flies emerge all at once.
Why adult mayflies live only one or two days and have no mouth parts.
Why some dragonflies spend most of their lives at the bottom of a pond.
Why mosquitoes buzz in people's ears (There is a children's book of a west African legend with this title by Vern Aardema, Dial Press.).

Activity 5
Adaptation - Be a Filterer

mayfly nymph

Background:

An animal's eating habits and habitat are reflected in its body form. Mayfly nymphs, which live on top of underwater rocks scraping algae, are streamlined and flat in cross section, living compressed against their rock homes. (A pet name among entomologists for these particular nymphs is "frisbee heads"--a name worth passing on to students if they find one during collecting trips.) Mayflies, which live under rocks collecting plankton away from the direct current, are round in cross section. Dragonfly nymphs have a jaw that shoots forward to catch its prey.

The small, dark, humped-back adult black fly has broad wings. This well-known, biting pest's larva has a swollen abdomen tip attached to the bottom of a stream. The larva's front end possesses fur-like structures to filter food from the water. Black-fly larvae require well-aerated, moving water, but they will do well in an aquarium if provided with lots of oxygen.

Any Alaskan who has seen a fisherman's "fly" has most likely seen a replica of an adult mayfly (Ephemeroptera), with its sail-like wings held upright over the back. The name "Ephemeroptera" means short-lived (ephemero) wing (ptera), referring to the brief life of the adult form.

Most people have witnessed the large emergence of masses of these creatures. The adult form's short lifespan necessitates this mass appearance, as there just isn't much time to meet a member of the opposite sex! The nymphs may live in the water from a few weeks to as long as two years. The adults may live for as briefly as a few hours. Mayflies are unique because of their "subimago," or "sub-adult" phase, lasting from a few hours to a few days between their nymph and adult stages.

The adults lack mouth parts, and do not feed during their short existence. The nymphs are herbivores. They live in clean, well-oxygenated ponds and streams.

The mayfly nymph can be distinguished by three (occasionally two) filaments ("tails") at the tip of its abdomen, and also by the presence of paired gills on the abdominal segments.

Collecting is invariably successful because of the variety of mayfly nymph habitats. Collecting techniques include sweeping shoreside vegetation, straining pond mud, searching the tops and bottoms of stream rocks, and agitating a pebbled bottom while someone holds a screen or net downstream.

Mayfly nymphs can be reared in any aquarium if supplied with their particular food. Those found in running water must be kept in cool or cold water that is well-aerated.

Materials:

- paper
- crayons
- worksheets:
  ...Mayfly (8F)
  ...Black Fly (8G)

Vocabulary:

- adaptation
- mayfly
- black fly
- filter

Procedure:

1. Ask students: what is it about a wolf that helps keep it alive? (teeth for killing prey and ripping meat, fast long legs for chasing, fur to stay warm) Explain that these features, which make an organism suited to how it lives, are called adaptations. Write the word on the board and have a student look it up in the dictionary. Why don't fish live on land? Why don't people live in the water? (They aren't "adapted" for it.) Discuss how people are adapted to survive.

2. Explain to students that they are going to become animals. They will be given certain information about the animal and where it lives. With that information, have them draw pictures of their new selves.

3. Write the following features on the board:

   you live on the bottom of a stream, which is covered with rocks
   you have to keep from letting the water push you away
   you feed on small organisms that are in the water, so you need some way to catch these as they float by

4. Have students share their creatures. Then pass out the worksheets on mayflies and black flies and point out how these creatures fit the situation described. (Black flies attach themselves to the bottom and put up fans to catch passing food; mayflies flatten themselves against rocks to keep from being swept away, and also filter the water for oxygen with hairs on their front legs.)

Activity 6
The Predacious Diving Beetle

Background:

Students will most profitably observe insects in relation to the other animals and plants that share the insect habitat. Plants, for instance, are the initiators of the food web, of which insects are a part. The plants gather sunlight, water and oxygen to make food. The insects and other animals of fresh water can be split broadly into 1) those that feed on the plants, and 2) those that prey on other animals.

All these plant eaters are eaten by stoneflies, dragonflies, damselflies, beetles, bugs or small fish. These predators are in turn preyed upon by larger predators such as fish, birds or mammals.

The key feature of the food web is the interconnection among all its participants: mayfly larva eats plants, and both fish and birds eat mayfly larva. Then larger predators eat the fish and birds.

In discussing these interactions within the food web, the human factor is important to acknowledge. Humans enter the web both as top predators eating fish, birds or mammals, and also at lower levels by removing streamside vegetation or creating dams that alter the food supplies.

The plants and rocks, in addition to providing substrate for food, are also important as animal homes.

The entire pond or stream community influences--and is influenced by--the insects found there. Many ecologists see insects as the link between the ecologically significant micro flora and fauna, and the sport and commercial fish of human interest.

The beetles (Coleoptera: coleo, sheath; ptera, wing) are the largest order of insects. All beetle adults possess biting mouth parts and hardened forewings, which cover the topside of the abdomen and meet in a straight line. The predacious diving beetles (Dytiscidae) are the largest family of aquatic beetles and the most likely to be found in Alaska.

Adult dytiscids breathe air under water by holding a bubble under their forewings. Every few minutes they must surface to trap another bubble. They can be seen head down at the surface, abdomen poking up to capture air. These large, shiny, black or brown insects are voracious predators. They eat other insects, and the larger ones will attack even small fish or tadpoles.

In the dytiscid, metamorphosis is complete. The predacious larvae sometimes are called water tigers. They are elongated, with an eight-segmented, tapered abdomen that lacks gills. Clean substrate and aquatic vegetation are necessary for their existence.

Beetles usually can be captured by sweeping a net over the bottom of a pool or pond. Both adults and larvae are interesting to observe in an aquarium, but will prey on smaller aquarium life.

Materials:

- paper sacks
- old nylons, rags or scrap paper
- specimens of predacious diving beetles
- crayons
- rubber band
- paper
- tape or staples
- open playing area
- worksheets:
  ...Predacious Diving Beetle (81I)
  ...Insect Predators (81)

Vocabulary:

- predacious diving beetle
- predator
- tadpole

Procedure:

1. Ask students what they like to eat. Some probably prefer meats, while others prefer plant foods such as vegetables or fruit. Insects have their preferences as well. Discuss insect food habits they already know about (grasshoppers eat grass, flies like dead salmon and other carrion, mayfly and black-fly larvae eat plankton).

2. Pass out the Predacious Diving Beetle worksheet. Have students color the illustration and discuss the eating habits of this fierce beetle.

3. The predacious-diving-beetle game simulates the relationships between beetles and other pond organisms. First, make the players by using lunch sacks, crayons and brown construction paper to create several predacious diving beetles. Leave the "beetles" empty and open for now. Tadpoles can be made out of nylon stockings, or improvised with rags or scrap paper.

4. Now you are ready for action. Designate two students as beetles, having them take their "sack beetles" in hand. Have the rest of the students be either tadpoles or water weeds.

5. During the game, the predacious diving beetles chase tadpoles, who take refuge in the weeds. The tadpoles are "safe" by touching the weeds. When caught, the tadpole goes into the beetle bag and the tadpole student becomes a beetle.

6. After a few minutes, stop the play. Have all the empty beetles turn into weeds and continue play. (Beetles die and turn into nutrients for plants.) Stop again after another few minutes. What has happened? If there are no tadpoles, what does that indicate? (too many beetles) What will eventually happen? (beetles starve to death, too) The moral is that it is best for all if there is a balance among organisms. Try playing again with a variety of ratios of organisms.

7. Finish your craft projects by stuffing beetles with tadpoles or newspaper. Then decorate the classroom with them.

8. Use the Insect Predators worksheet as a follow-up.

Activity 7
The Dragonfly at Home - Habitat

The scientific term for dragonflies and damselflies is Odonata, derived from the Greek word odon, meaning "tooth," referring to insects' large mandibles.

Most of us are familiar with the adult forms of dragonflies and damselflies (Odonata), with the dragonflies spreading their wings at rest, while the more delicate damselflies hold their wings over their backs.

The immature of these are nymphs. The dragonfly nymph is a stout-bodied fellow with gills hidden inside the abdomen. The damselfly nymph is elongated and slender, possessing three leaf-like gills at the tip of the abdomen.

In both the nymph and adult stages, dragonflies and damselflies are hearty predators, especially of mosquitoes. Sometimes they stalk their prey in shoreside vegetation, while other times they will submerge themselves in bottom mud in order to pounce on an unsuspecting passerby. The labium (or bottom jaw) of the dragonfly forms a mask, which can be "shot" out to one-fourth of the animal's length to grasp its prey. The dragonfly can use its internal gill chamber to expel water and move by jet propulsion.

Damselfly and dragonfly adults can both be observed mating in flight. After mating, the females of some species fly low over the water, laying eggs as they dip their abdomens into the water. Other species lay their eggs in aquatic plants or bottom mud. The nymphs can be collected either by sweeping aquatic vegetation or by straining the bottom litter, or mud. They are hardy in the aquarium, but must be kept well-fed or they will prey upon other organisms in your care.

The place where an organism lives is called its "habitat." Each habitat must provide a space for the organism, as well as the food and water necessary for survival. Many insects live in water as immatures, but become terrestrial as adults.

A major distinction between habitats in a freshwater system is whether the water is flowing or not. Extremely rapid current may render the environment intolerable for life. Similarly, an extremely slow current might collect so much silt as to also be unsuitable for life.

The edge of the water is the "shore zone," where rooted plants provide home and sustenance for a variety of animals. In this region, such creatures as dragonfly and damselfly nymphs and snails attach themselves to water lilies and pond weeds, while stickleback fish might hide below. When wave action is extreme, aquatic flowering plants are absent, but algae is present. The shore zone is the richest for pond explorations. By sweeping

collection nets through the vegetation, it is possible to turn up an abundance of invertebrate life.

In the "open water zone," the shore and bottom have less influence. There is plant life in open water, represented by the floating algae called phytoplankton. Zooplankters, many of them crustaceans such as copepods and Daphnia, also thrive in this region. Here is a chance to try your plankton nets. You'll find that the nets also occasionally catch larger free-swimming organisms such as fish and diving beetles.

Students can watch water striders and other surface-dwelling organisms walking or swimming on the surface tension of the water.

The bottoms of rivers, streams, ponds and lakes provide habitat for invertebrates. The nature of the bottom is important in determining what lives there. In general, the more complex the substrate (that is, the more different kinds of bottom material), the more diverse will be the invertebrate fauna. Bottom organisms either burrow into the bottom, attach themselves to the substrate, or swim along the bottom.

Mud is found in freshwater areas where water is slow-moving. Midge, mosquito and other fly larvae are found in abundance in mud-bottom habitats, along with less abundant mayflies, dragonflies and damselflies.

Because of its uniform nature, sand provides a relatively poor substrate for life in fresh water. Sand is typical of freshwater areas where flowing water has slowed, such as eddies and creek edges. You will find only a few specimens of a few species, such as midges and mayflies, in sandy regions. Mayfly and stonefly nymphs, in addition to caddis-fly and black-fly larvae, can be found attached to rocks in freshwater streams and rivers. Because rocks make good anchors and offer many protective niches, rock bottoms are among the best places to look for insects. Bedrock is often found where the current is so swift that the force has carried away even the larger stones. Such swift currents may carry away organisms, too. Although black-fly larvae are usually the last to go, the crevices in bedrock may also harbor mayfly, stonefly and caddis-fly young.

Aquatic insects that have adapted to fit their habitats are dependent on these settings for existence. But when humans change habitat, they also change the nature of its life. For instance, a dam causes siltation upstream, which changes the nature of the stream bottom and eliminates creatures depending on rocks or rapidly moving water. The water behind the dam also collects inflowing nutrients, changing the downstream food supply. On a smaller scale, removing logs and debris from a stream or river alters habitat, and therefore eliminates or at least changes populations. The greater the diversity of habitats available, the more different kinds of associated organisms can be found. In any case, it is important to note that unnecessarily changing habitat is not a good idea.

Materials:

- crayon
- scissors
- worksheets:
  ...Dragonfly (8J)
  ...Dragonfly Home (8K)
  ...Insects at Home (8L)

Vocabulary:

- habitat
- home
- food
- water
- shelter

Procedure:

1. Write the word "habitat" on the board and explain that a habitat is an organism's home. Where is the students' habitat? Where is an insect's home?

2. Use the Dragonfly worksheet to introduce dragonfly and damselfly life habits.

3. Return to the idea of habitat. Ask students: what is necessary for survival? (food, water, shelter) Explain that the habitat must provide these things.

4. Use the Dragonfly at Home worksheet. Cut up the parts and have each student arrange them on another sheet. Explain to students that you are going to create a picture of a dragonfly habitat. Start with the adult dragonfly. Where is its home? (in the air) Place it on your paper where air would be. What does every habitat have to provide? (food, water, shelter) So what is adult dragonfly food? (mosquito) Place it in the habitat. Where will it get water? (pond) The students need to draw a pond. An adult dragonfly's shelter is plants.

5. Continue in a similar manner with the dragonfly nymph. Food (immature mosquito), water (pond), shelter (bottom mud or submerged plants).

6. Expand their understanding to other insects with the Insects at Home worksheet and the following habitat activity.

7. Discuss what would happen if you pulled up all the plants (remove dragonflies, shelter and other organisms' food) What would happen to a mayfly if you took away the stone covering it? (lose home) Therefore, it is important to not only be careful of living things, but of their homes or habitats.

8. For the first round of the activity, the teacher will need to select the habitat types and do a good deal of student coaching. Discuss with students that each habitat must provide food, shelter and water for the organisms. Give examples of well-known organisms and their habitats: organism, stonefly; habitat, stream; shelter, under rock in stream; food, other insects. Here's another: organism, mussel; habitat, beach; shelter, stump or rock; food, plankton.

9. Split the class into groups of about eight students. Assign each group a secret habitat (pond, beach, wet tundra, village community, city neighborhood). Have each group

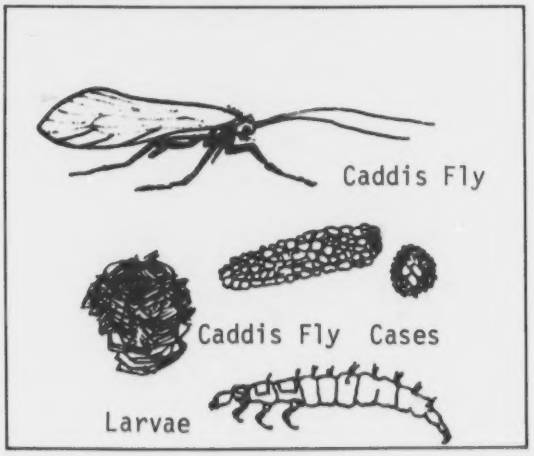
design a pantomime that acts out the habitat.

10. Reassemble the class and have each group perform its habitat, having the rest of the class guess the habitat. Rules for the performance are: without the audience saying anything, the audience must think quietly about the habitat until the performers are done with their act. When complete, students can raise their hands to propose a habitat. Remind the audience they are to recognize a particular place, not the specific animals that live in that place.

11. Discuss the inclusion of the village or neighborhood as "people habitat." (Though a bit of a "ringer" in the game, it is an important inclusion.) Students need to be able to transfer the ideas gained in these exercises to their own lives.

12. Ask students: what might the addition of human habitats do to ponds and streams? What would happen if you built a road next to a stream? What if you filled in a pond to build a shopping center?

Activity 8
Go Home Caddis Fly



As a not-too-showy adult, the caddis fly is inconspicuous and dull-colored, its hairy or scaley wings like a moth with a tent on its back. On the other hand, the caddis-fly larvae are likely to be big hits in your classroom.

Though terrestrial as adults, before maturity caddis-fly larvae inhabit all types of freshwater habitats. But after spending the majority of their lives as larvae, they undergo a complete metamorphosis. But prior to that, the larvae and short-lived pupae inhabit cases, which is always popular with students. The cases are made of vegetation, rocks, sand grains, or a fine net.

The larvae have hard plates both on the head and on the last part of the thorax. The abdomen is soft and lightly colored. Jointed legs are attached to the thorax.

The caddis-fly larvae's feeding habits vary. Some eat streamside debris. Others scrape algae from submerged rocks. Yet another group collects plankton in a net.

With their heavy cases, caddis larvae are easily collected by picking the larvae and cases from rocks, or sifting them out of debris. The larvae do well in an aquarium with moderate aeration and an adequate food supply.

Materials:

- caddis specimens and illustrations
- worksheet:
  ...Caddis Fly (8M)

Vocabulary:

- caddis fly
- cases
- building materials
- predator

Procedure:

1. Either pass around actual caddis fly larva specimens and cases, or show pictures of them to the class. Ask students if they have ever seen things like this before. Postulate with them about how caddis fly larvae build these neat little portable homes. What are the building materials of the students' own homes? What did people use who lived where they do 100 years ago? (native materials) Caddis fly larvae and our own ancestors are similar in some ways, with both groups dependent on resources found nearby.

2. Go over the Caddis Fly worksheet with your students. Make special note of cases by explaining about case composition.

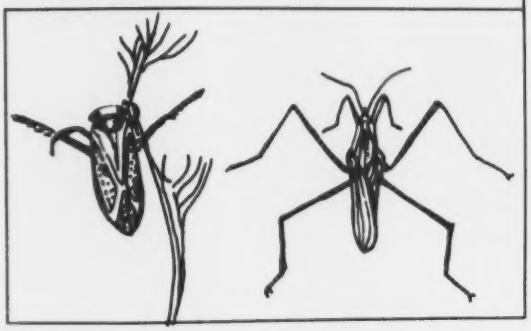
3. If disturbed, caddis-fly larvae will leave their cases, returning later. Or, they may build new ones elsewhere. In the simplest version of this activity, count the children out by threes. The ones and twos stand still and hold hands in an arch to form a "caddis case." The threes are the "caddis larvae," which live in the cases. On a signal from the teacher, the larvae leave their cases and run around to find another.

4. In the next scenario, the ones and twos start out as cases, with threes safely inside as larvae. The teacher then announces a change in players--the ones and threes become the cases and the twos the larvae. Play is then repeated, letting the ones be the caddis flies.

5. An additional level of difficulty adds a new challenge. When this variation begins, all caddis larvae are in their homes, except for one homeless "it" with no case. On a signal from the teacher, the caddis larvae must all change cases, and the one caseless caddis larva tries to beat others to an empty case. The caddis larva having no case is now "it."

6. The next level adds a predator. There is still one larva too many for the cases, but this time an additional child is a "trout." The trout chases the caddis, which is "safe" by getting into a case. There can be only one caddis per case, so an incoming caddis displaces the resident (unrealistic, but fun). If tagged, the caddis larva becomes a trout and the trout a caddis larva, whereupon the chase resumes.

Activity 9
Bug Run



Although all insects are often simply referred to as bugs, a particular order of insects actually exists bearing the scientific term, "bug." These "true" bugs undergo a gradual metamorphosis. They have piercing, sucking beaks. These partially horny creatures have somewhat transparent wings that often form a leathery triangle behind the thorax. The adults and nymphs resemble each other both in appearance and life habits. The aquatic species of the bug order remain aquatic throughout their life cycle.

These "true" bugs are the Hemiptera (hemi, half; ptera, wing). Those associated with water environments use atmospheric oxygen. Different kinds of bugs use various strategies to get this oxygen. Some hold air bubbles under their wings and return to the surface when the bubble is depleted. The two families of bugs found most commonly in Alaska are the water striders (Gerridae) and water boatmen (Corixidae). The water striders skate along on the tension of the water surface, rarely submerge, and have breathing methods characteristic of terrestrial insects. The water boatmen hold air in a fuzzy hair covering.

The water striders are black, long-legged inhabitants of the calm areas of ponds, streams and rivers. Some species are found in marine environments. Typical of the true bugs, water striders are predacious. Their forelimbs are modified to catch prey, which they find just below the surface. Their beak is used to suck the juices from their prey. One must be quick to catch them as they dart across the water surface. Because of their quick movements and existence above the water surface, it is difficult to confine them to an aquarium.

The water boatmen (Corixidae) swim in the water column of ponds and lakes in staccato, jerking movements, propelled by their oar-like hind legs. Boatmen vary in both their form and habits. Their mouth parts are also shorter than the typical bug beak. Some are predators, while others scavenge debris, algae and protozoa from the bottom. They are most often collected by sweeping a net through the water.

An aquarium must have a lid to adequately contain water boatmen, water striders and other bugs, as the adults would otherwise be able to fly out. Collect food for water boatmen from the pond or stream where they were caught. They can survive on leaf litter, vegetable litter, or rich sediment.

Materials:

- water strider specimens and illustrations
- water boatmen specimens and illustrations
- scrap paper
- detergent
- dish pan
- worksheet:
  ...Bug Run (8N)

Vocabulary:

- "true" bug
- breath
- breathe
- water strider
- surface tension
- water boatmen

Procedure:

1. Pass around specimens or show pictures to introduce students to the boatmen and striders, which are among the most active of the water insects. Have them count legs and observe features of the insects.

2. Point out that these insects are true bugs; that is, the ones that scientists refer to as bugs. They undergo gradual metamorphosis and piercing beaks. Though they live in water, they must breathe air like people.

3. The water strider manages to get its air by never really swimming, but by always staying out of the water on its stilt-like legs. Have students make water striders out of paper and float them on the water. Demonstrate that if you push a water strider through the surface of the water, it will sink. The real or make-believe water striders stand on the water surface tension.

4. Detergents break down surface tension. A drop of liquid detergent behind the "water strider" should make it first run forward as the tension breaks. But then they sink, because of no tension to stand on. Be sure to rescue your water strider!

5. Water boatmen have a different strategy for getting air. Rather than staying in the air, they take the air under water with them. The body is covered with fine hairs that hold a film of air which the bug can breathe.

6. Water boatmen occasionally must rise to the water surface to replenish their air supply. Use the Bug Run worksheet and help the water boatmen get to the surface. The water boatman in this sheet is feeding on debris in the bottom, and must rise to the surface through a maze of water plants and predators.

Why We Have So Many Mosquitoes

Since the earliest times, people have puzzled over why Alaska has so many mosquitoes. A number of legends speak to this. Most of them probably have not been written down, but nevertheless continue to be passed along orally from one generation to the next.

This panel of linoleum block prints, by well-known Tlingit artist Shanon Gallant, illustrates a legend she was told as a child by her grandmother, who is Jessie Kasco of Klukwan. (Klukwan is a Tlingit village north of Haines in Southeast Alaska. It is a good legend for that part of the country because Haines, as you remember, is about as far south as the big "snow mosquitoes" stray.)

"I had been playing outside and got bitten pretty badly," Gallant told Tidelines, a monthly science publication for Alaska school children, "and this is my grandmother's story as I remember it."

"Raven, of course, was a magical, mythical being with great powers. He did good things, like opening the boxes that let out the sun, moon and stars, bringing the world light. But you couldn't always trust him because he liked to play tricks. Anyway, here's the legend..."

"Why We Have So Many Mosquitoes" is excerpted and adapted from Alaska Tidelines, Volume III, No. 8 May 1981. Virginia Sims, editor. Published by the University of Alaska Sea Grant Program, Copyright © 1979. Reprinted by permission.

A long time ago before the white people came, there was only one mosquito in the world: a giant, blood-thirsty mosquito.

1. One night the giant mosquito crept into a village unnoticed by the people. Only Raven, who was flying overhead, saw it by the light of the moon. (The three white spots inside the circle on the Tlingit moon symbol mean it was a three-quarter moon.)

2. When the sun came up the next day, the mosquito pounced on the weakest person in the village and sucked up his blood. The mother seized her baby and ran off to hide. Her husband and the wise old man of the village watched helplessly, shaking with rage.

3. That evening while the saddened people were sitting around the fire, Raven came to talk to them. "Why do you put up with that terrible mosquito?" he asked. "You should capture it and burn it in the fire. Then you will be free of it." The young husband thought that was a good idea, but the wise old man wasn't so sure. "I have a feeling that would only make things worse," he said. "Perhaps the mosquito won't come back again for a long time." But no sooner had he spoken than they heard the whirr of huge wings.

4. That was too much. The people knew of the mosquito's habit of always stopping to take a drink of water from the sea. So the wise man and the young husband quickly got the biggest fishing net in the village and captured the mosquito. "You had better let me go," said the mosquito. "You will pay a million times for this!"

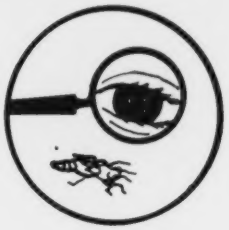
5. But they dragged the giant mosquito up the beach and threw it upon the fire. As it burned, great black clouds of ashes rose into the air. And each ash turned into a tiny mosquito. "What have we done!" cried the people, as the mosquitoes swarmed around them. And Raven, the trickster, flew away laughing.

Why We Have So Many Mosquitoes

Shanon Gallant is a talented young Alaskan artist, born in Skagway and reared in Juneau. After graduation from Stanford University in California, Gallant studied art at the Rhode Island School of Design in Providence, including a stint at its overseas campus in Rome. Now living in Anchorage, she works in numerous art media, including contemporary sculpture in plexiglass, bronze and stainless steel. She also does woodcut and linoleum-cut prints, as well as painting in oils, airbrush and watercolor. Gallant always incorporates traditional Tlingit design into her modern creations, which she says "makes a nice marriage."

The preceding article is excerpted and adapted from Alaska Tidelines (see credit at beginning).

Unit Nine
Freshwater Field Trip - "Look Closely"



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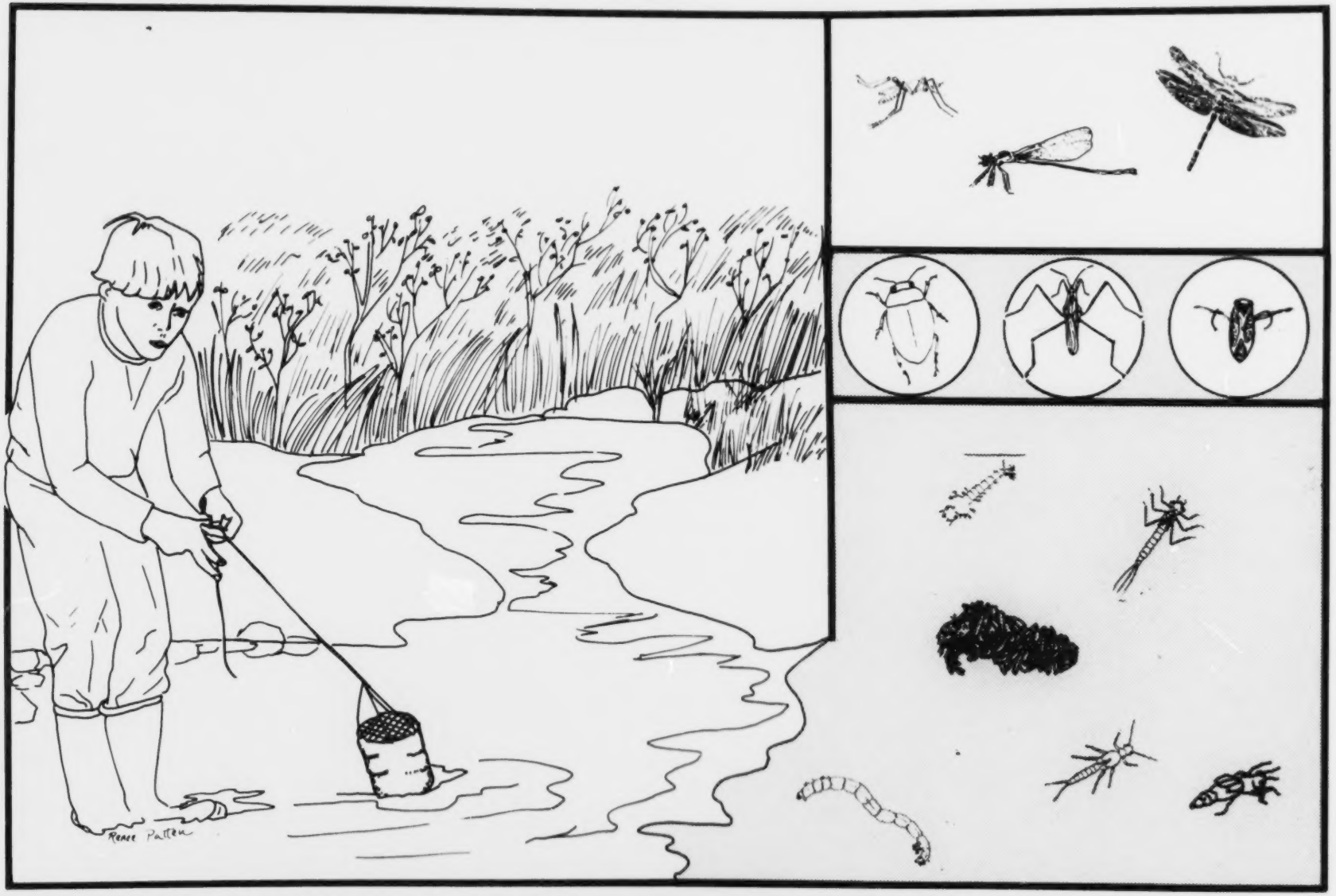
Objectives:

To help students:

- Explore a freshwater system (Activity 1).
- Observe insects in their natural habitats (Activities 2, 3, 4, 5, 6).
- Become familiar with the feeding behaviors of insects (Activities 2, 4, 5).
- Collect insects for field and classroom examination (Activities 3, 4).
- Record field observation data (Activities 4, 6).
- Develop respect for insect life and habitat.



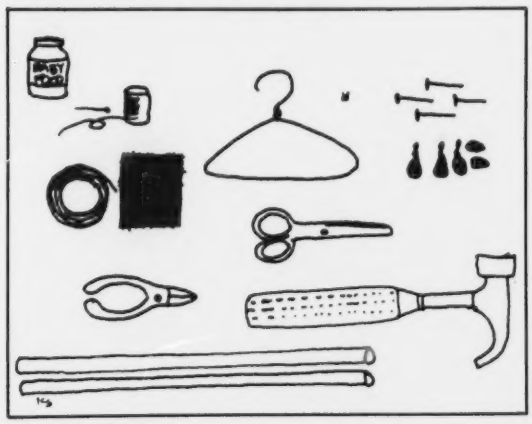
Unit Nine: Freshwater Field Trip--"Look Closely". Students will find adult flying insects in the air above fresh water. Adult beetles and bugs live either on the surface or they swim in the water column. Immature insects either float on the surface, climb on vegetation, or cruise on the bottom.

The sea shell field trip introduction outlines field trip philosophy and logistical considerations. Please refer to this orientation and the 'How to Use the Book' section before planning the specifics of your freshwater field trip.

Both ponds and streams yield rich (though different) fauna. Ponds sometimes are easier for young students to approach. On the other hand, many small streams are only a few inches deep, and therefore safer. When choosing field trip water, note its accessibility (repeated short trips are preferable to a single visit), depth, the steepness of its bank, the room children will have to explore, and the area's richness of animals. Not finding animals is discouraging; to insure student success, choose an area with a diversity of plants and insects. An area with a diversity of freshwater systems--ponds, streams, muddy bottoms, rocky bottom, varying currents and vegetation--will yield the greatest variety of invertebrates.

The following field trip is similar to the beach field trip: field trip preparation, initial exploration and class instructions, small group exploration, class explorations, review, sharing and closing activities. One field trip with your class could include all or just one segment of recommended activities. In any case, have students start to create their pond books and task cards beforehand. In addition, have a "dry run" on the playground the day before. These preparations will also demonstrate to students the importance of planning.

Activity 1
Field Trip Preparation



Materials:

- string
- baby food jar and lid
- hammer
- needle and thread
- rubber band
- nails
- nylon hose or parachute nylon
- tape
- fishing weight
- clothes hanger
- paper
- scissors
- crayons
- wire cutter
- coffee can
- two 5/8-inch dowels, 3 inches long
- two feet of 24-inch fiberglass window screen
- worksheet:
  ...Field Trip Book (9A)

Vocabulary:

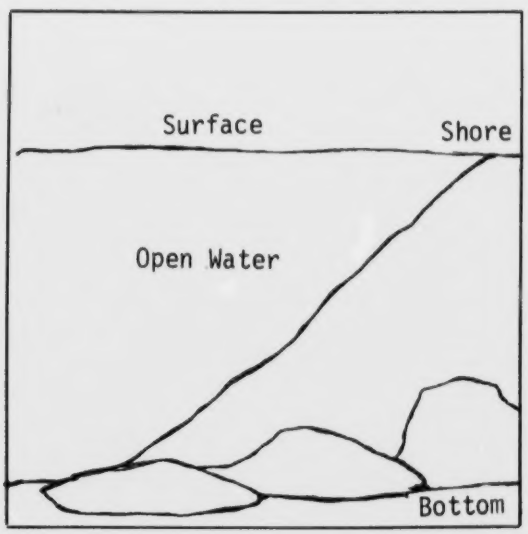
- surface
- shore
- open water
- bottom
- dredge
- plankton
- rules
- etiquette

Procedure:

1. Refer to the logistical field trip planning suggestions in the sea shell field trip (Unit Six).

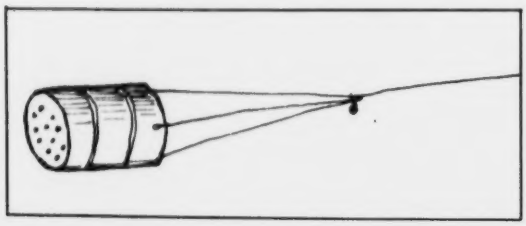
2. Announce your field trip intentions and ask students what they think they will find. List the student responses on the board and add some of your own to include all components of the pond system. (Items in the list might include willows, water lilies, dragonfly nymphs and adults, caddis larvae, mosquito larvae and adults, water striders, water, sand, mud...)

3. Draw a cross-section outline of the pond on a bulletin board. Have students draw pictures of the listed components and then place them on the cross section where they think they will find them on their field trip. Mud, sand or rocks can be drawn right into the outline. Point out habitat divisions: surface, shore, open water, bottom.

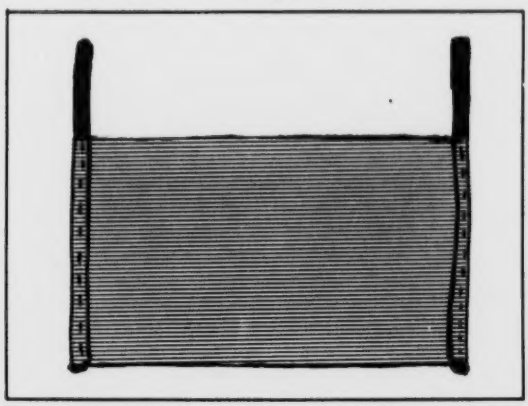


4. Make plankton nets--see Unit Six, Activity 2.

5. Make a bottom dredge: poke holes in the bottom of a coffee can with the nail and hammer. Use the same method to poke holes at the rim of the can to attach a bridle. Put a weight on the bridle and attach the bridle to a tow line.



6. Make a couple of collecting screens, especially for stream trips. Attach the ends of a two- to three-foot length of 18- to 28-inch fiberglass screen to two dowels. The dowels should be larger than the screen and shorter than the child who will use them. Willow sticks may be substituted for the dowels. The sticks or dowels should be sturdy, about one-half inch in diameter. The screen should be even with one of the ends of the dowels, as illustrated, and may be tucked or stapled on.



7. Make rules for the field trip--see Unit Six, Activity 1. This step is important for both the safety of the students and the environment they are visiting.

8. Make a "Pond and Stream Book" following the procedure in Unit Six, Activity 3. For the book's task cards, select tasks appropriate to the sites you will visit. Use tasks adapted from the Field Trip Book, and the task cards in Activity 4 of this unit, or design your own. Teachers find a more enthusiastic reaction to task cards designed and distributed according to student interest.

9. Practice the field trip. The day before the actual trip, have students bring appropriate clothes and gear. On the playground, simulate the field trip to familiarize students with equipment and task cards.

Activity 2
Initial Exploration - Arrival Fun

Materials:

- plankton net
- kitchen sieve
- light-colored dishpan
- jars
- stream screen
- collecting net (optional) or
- sieve with stick attached to handle
- bottom dredge

Procedure:

1. See Unit Six, Activity 4 regarding field trip exploration activities.

2. Students may simply explore unaided, or you may want to demonstrate the equipment and collecting techniques at this time.

   Sweep the collecting net through the plants at the water's edge. Turn the net inside out and empty a small amount of its contents into the bottom of a (for contrast) light-colored dishpan with a little water.

   Sweep the collecting net through the water at the edge of a pond or stream, and similarly empty the contents

into the dishpan, watching for movement to spot small organisms.

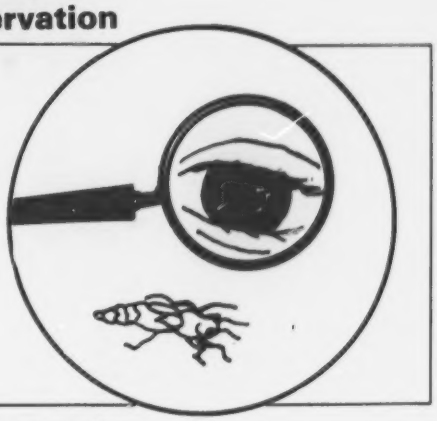
Throw the plankton net out into the pond and draw it back to you. You can leave the planktor net in a stream, letting moving water carry organisms into the net. A plankton net, however, is usually more successful in a pond than in a stream.

Collect mud from different spots with the bottom dredge. Put the mud in the sieve and wash it by gently swishing water through the sieve. Put the remaining debris in the bottom of a dishpan with a little water. Pick through it, watching for movement.

Turn over rocks and look for animals hiding under or attached to them. (Be careful to return the rock to its original position.)
In a stream, have students hold a collecting screen downstream from where another student dislodges organisms by stirring the stream bottom. Empty the screen by washing its contents into the dishpan. A collecting net or sieve can be used similarly. Caution students about disrupting habitat too vigorously, or muddying water so much that it hinders students investigating downstream.

3. Insects can be observed in a dishpan by watching for movement. Help students look for and identify movements. Observe the movements of the organisms you find, and point out key characteristics. Ask each student to keep in a jar one of each different organism they find.

Activity 3
Observation



Background:

Regroup after the free exploration, and as you distribute equipment, focus the group's attention on investigation techniques and equipment.

Vocabulary:

- observe
- senses
- similarities
- differences
- current

Procedure:

1. Introduce the word "observe" by asking your class to define it. Observing includes looking closely, but also involves other senses besides sight. Tell students that in order to have a successful field trip, they will need to be good observers.

2. Have students look for patterns in the water and surrounding area. As a group, make some sensory observations:

   - How many different colors can you find?

- How many sounds can you find after you close your eyes to concentrate?

- What can you smell? Does one part of the pond smell different from others?

3. Analyze the pond and/or stream environment. Look for similarities and differences from one part to the next:

   - Is there vegetation? Where? What kind?

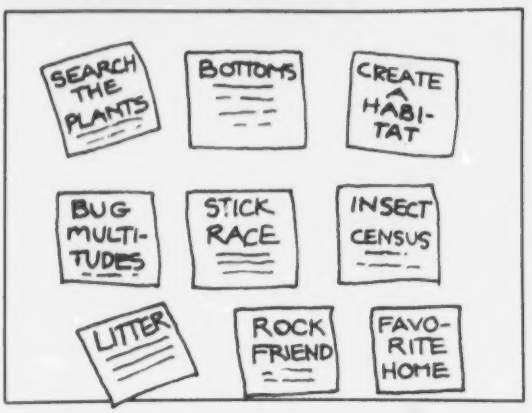
   - What does the bottom material consist of? Mud? Sand? Rocks?

   - Where does the stream's current change? Why? Where is the water clear? Where is it murky?

   - Is the pond water clear everywhere? Is it murky anywhere?

4. Explain that the equipment made by students beforehand will now help them to observe the pond and its life.

Activity 4
Structured Activities



Materials:

Each student
- pond or stream books
- pencils

Each group
- task cards
- kitchen sieve
- magnifying lens
- plastic spoon
- light-colored dishpan
- collecting jars

Whole class
- plankton net
- bottom dredge
- stream screen
- masking tape
- collecting net (optional)
- finger bowl, petri dish (optional)
- binocular/dissecting microscope (optional)
- field guide, insect ID sheets

Procedure:

1. Split the class into groups of three, giving each group its material. (The groups rotate use of the more specialized equipment.)

2. When choosing an overall study area, find areas with diverse habitats: look for a stream/pond combination with sandy, muddy and gravel bottoms; fast and slow currents; vegetated and barren spots. Have each group choose differing places to investigate.

3. Instruct groups to explore their particular areas as thoroughly as possible. Have them collect organisms and note characteristics as they coincide with activities agreed upon in class.

4. Students can work entirely from their pond books, noting organisms as they explore. Or, they can use their books to keep track of what they find as they follow the instructions on other task cards.

5. Make task cards by writing the following tasks on squares of heavy paper. The task cards will help guide students in their habitat investigations. Students can work through them either individually or in small groups (with the aid of chaperones). Chaperones distribute tasks and explain them to students, who trade completed task cards for new ones.

WATER, WATER

What is the water like?
Is it still, slow- or fast-moving?
Is it clear or cloudy?
Does it look the same throughout your area?
Is it warmer or colder than the air?

PICK YOUR HABITAT

In your field book, draw a picture of your study area.
Put an "X" on the spot where you would live if you were an insect.

SEARCH THE PLANTS

Are there rooted plants in the water?
What plants are growing along the bank?
What insects are around the plants?
Which plants have the most insects?
Draw a picture of the most common plant in your field book.

INSECT HABITAT CHOICES

What insect lives on the bottom?
What insect lives on the surface?
What insect lives in the open water?
What insect lives along shore?

BUG MULTITUDES

Where do you find the most insects?
Where do you find the fewest insects?

FUN TO BE

If you could choose to be an insect, which do you think would be most fun?

CREATE A HABITAT

Tie a string or rope on a can, tire, log or bucket. Place it in the water at your study spot. Return later to see if any animal has adopted it for a home. Be sure not to litter!

INSECT CENSUS

How many different insects are there?
Which insect is the most numerous?
Which insect is there the fewest of?

BOTTOMS

What is the bottom like?
Squeeze a handful of bottom material. Rub it between your fingers. Is it mud or sand? Are there plants or animals in it? How many different kinds of things are in a can full of bottom material?

STICK RACE

Find a friend to race sticks from one spot in the stream to another.

Which stick won?
Why?
Where is the fastest spot in the stream?

ROCK FRIEND

Find a rock friend. Carefully examine the rock.

What living things are on the rock?

Draw a picture of your rock friend in your field book. Be sure to replace your rock friend where you found it.

Who do you think are the rock's friends in the stream?

PANTOMIME

Find a friend and imitate the following roles. See if your friend can guess what you are:

a bird catching a water insect

an insect nymph or pupa emerging into an adult and flying away

a frog or toad catching a mosquito

a dragonfly

an idea of your own

LITTER

Collect litter. Put all your litter in one spot. What clues does it tell you about who has been here? Make a story based on the litter you find. Put the litter in a bag to throw away.

WATER MYSTERY

Find clues to a water mystery, explain the clues and tell a story about what happened. (Sample clues: track on the bank, broken or gnawed-off stick, a pile of feathers)

NOT LIVING

List in your field trip book at least five non-living materials at the trip site.

Put a star by those that occur naturally. (In other words, those not there because of humans.)

Put a second star by the materials necessary for life to survive.

6. The following tasks investigate a single insect in much greater depth, rather than just studying the spot, habitat or study area that the preceding cards cover.

INSECT FOOD AND HOME

Observe one insect.

Where is it found? (bottom, under rock, surface, open water, shore)
Can you find its food source?
Where was it living?
What might eat it?

MOVE INSECT MOVE

Observe one insect.

Does it move fast or slow?
How does it move? Does it swim, crawl, or float?
Can you imitate its movement? Can your partner tell what you are imitating?
What parts of its body does it use to move? (use microscope or hand lens)

NAME IT - KNOW IT

Observe one insect.

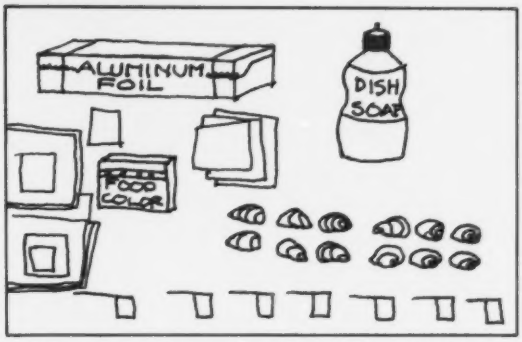
What is its name?
If you were going to name it, what would you call it?
What special characteristics does it have? (bright color pattern, tail appendages, big eyes, long antennae, hairy legs)
Draw a picture of it.
Is it an adult, nymph or larva?

FAVORITE HOME

Observe one insect.

How many others like it are around? Check with other members of your class. (none, few, some, many)
Where are the most of this kind of insect?
Where do you find the fewest?

Activity 5
Reports and Class Experiments



This is a time to give the children an opportunity to share their discoveries. After their initial sharing, organized experimentation will reinforce principles being learned.

Materials:

- paper scraps, paper, styrofoam, foil
- detergent
- food coloring
- seven toothpicks with masking tape flags per group
- four snail shells per student

Vocabulary:

- caddis fly
- cases
- surface tension
- water strider
- currents
- jet propulsion

Procedure:

1. Ask each group to decide and then show the most interesting thing each found. After this initial sharing, have students release all insects except those needed for parts 3, 4, 5 and 6 (dragonfly, caddis flies, water strider).

2. Check the homing instincts of caddis flies--discovered by carefully removing some from their cases. Keep track of which case is which. Put the caddis flies, their empty cases, as well as some other empty cases in a dishpan of fresh water. See whether the caddis flies return to their own cases. Have a race! Whose caddis fly returns fastest? Remove all the cases. Give the larvae some other materials for the construction of cases, such as beads, small pieces of aluminum foil, string and styrofoam. What happens?

3. Watch a water strider in the water. On a sunny day, students can see the round shadows that the legs of the striders cast by the dimples created on the surface tension of the water. Detergents break down the water's surface tension. Put the strider in shallow water in a dishpan. Place a drop of detergent on the water near the strider. Without surface tension, the strider sinks. Be sure to rescue the strider, as most striders do not have provisions to breathe under water!

4. At a stream, play "Pooh Sticks." Currents are critical elements in the lives of creatures that live with them. Organisms in streams depend on the current for oxygen and food. Students will understand currents better by observing them. Racing sticks under a bridge or between two points on the bank can provide this awareness. Have students collect one stick each. Go to the

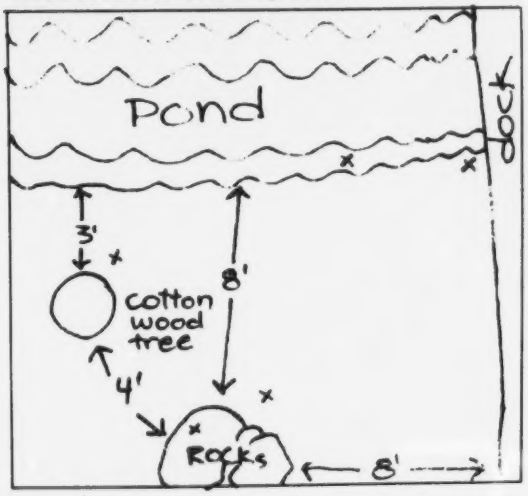
upstream side of the bridge and have students drop (not throw) their sticks straight over. Go to the other side of the bridge and see which stick arrives first. Did some sticks never arrive? What was the shape and size of the winning stick? What happened to those sticks that never appeared? (If a bridge is not available, have students stand across the stream with their sticks and release them simultaneously. Other students or adults can be posted at a finish line to announce winners.)

5. The dragonfly nymph breathes through a chamber at the end of its abdomen. This chamber also shoots the dragonfly forward by jet propulsion, in order to capture prey and escape predators. Students can observe the movement by gently prodding the nymph. The water exchange during breathing can be seen by dropping a drop of ink or food coloring near the nymph's tail, and then by watching the pattern it creates.

6. The bottom jaw of a dragonfly will "wow" your students. It is best to show it with a dead specimen. The bottom jaw is the grasping tool of this voracious predator, and has taken the life of many mosquitoes, so try not to harm a living dragonfly. Carefully grasp the bottom jaw from the mask it forms in front of its face. Pull gently down and then forward to its furtherest extent.

7. Make a natural wonders show. Have each team return to its study area with seven toothpick flags. The students put their flags in locations to mark seven natural wonders they want to share with the rest of the group. Each student is given four snail shells that she/he can use to purchase entrance to a natural wonders show. The teams then hawk their shows, trying to convince others to spend their shells on their tour.

Activity 6
Mark and Recapture



Background:

Scientists studying animal populations often capture, mark, release and later recapture animals, to learn about their movements and habitats. The animals are marked with tags, bands, fin or ear cuts, or even radios or transmitting collars.

In this exercise, students collect a number of an abundant species, mark them, and then observe their movements. If you are able to make only one visit to the site, you should choose a fairly rapid-moving and observable organism such as the water strider, whirligig beetle or even the adult dragonfly. If you can return to the site, the more sedentary caddis nymphs or snails are appropriate. The marking material will be determined by the organism chosen for observation. Fingernail polish works well on most hard-covered organisms--snails, water striders, beetles, or stone-cased caddis; colored string can be used to mark the cases of vegetation-cased caddis.

Materials:

- colored marking material
- colored pencil
- paper

Vocabulary:

- capture
- mark
- mop
- landmark

Procedure:

1. Divide the class into teams. Have students collect the study organism. If you plan to return after 24 hours or more, have them collect a dozen or two. If you are going to watch a rapidly moving organism for only a few minutes, then have them capture just one or two.

2. Give each team marking material of a different color. Mark the organism. Stress caring for the animal, being careful not to hurt it.

3. Draw a map of the study area, including distances from key landmarks such as a bridge, tree, or dock.

4. Release the organism(s), marking the spot on the map with a pencil of the same color as the marking material.

5. After a specified period, (five minutes, 15 minutes, one hour, one day, one week), collect the organisms and mark their new locations on the map. If possible, release and repeat.

6. What happened? How far does the organism range in the specified time? Were the

organisms concentrated in one area, or one kind of area, upon recapture? What do you think is the best habitat for your organism? Did organisms, released in one kind of habitat, move more or less distance than those released elsewhere?

7. How far do your students travel in a similar time period? Is there a place that they congregate or return to? Is there part of their environment they avoid and never go?

Activity 7
Predator - Prey Game

Predator	Prey
Fox eats	hare
hare eats	grass
bird eats	dragonfly
dragonfly eats	mosquito
person eats	bird

Background:

A final fun activity(s) will bring the group together, contribute to the sense of unity, and end the field trip on a positive note. This should be a success-oriented experience where no one loses or (does not know an answer.)

Vocabulary:

- predator
- prey

Procedure:

1. Split the class in half.
2. Line up the two teams facing each other, about six feet apart in an open area.
3. Designate goal lines 10 to 20 yards from each line of players.
4. Review the words "predator" and "prey."
5. Have two callers: the teacher and another person (preferably with different sounding voices). The callers always read or "call" for the same team. The entire team becomes the organism their caller says.

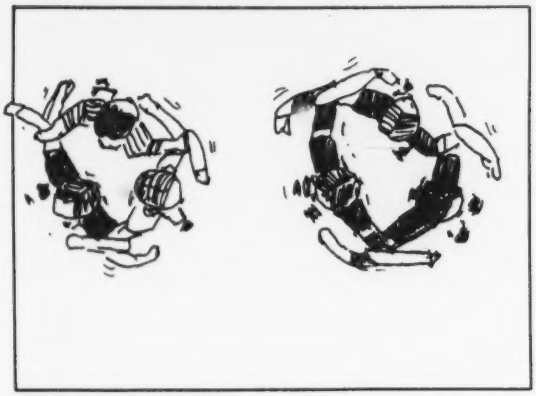
6. The predators chase the prey. For instance, if the teacher says "hare" and the other caller says "fox," the teacher's team races for its goal line and the other team members pursue, trying to tag them. If the teacher says "hare" and the other caller says "grass," the teacher's team would chase the other. The callers should rotate being first.

7. In the non-competitive version of the game, the original teams reassemble as they started. In a competitive version, those tagged join the other team and the game is over when there is only one team--in which case everyone is on the winning team in the end.

8. Suggested calls (a list really helps!):

hare	fox
hare	grass
mayfly	plankton
mayfly	algae
mayfly	fish
salmon	caddis fly
dragonfly	bird
dragonfly	mosquito
animal plankton	plant plankton
salmon	eagle
water strider	mosquito larva
leaf	caddis fly
black fly larva	plankton
minnow	predacious diving beetle
leaf	sun
turkey	pilgrim
person	mosquito (catch --no loosers)

Activity 8
Water Strider Race



Follow the instructions for the octopus race--Unit Five, Activity 5. However, this time the creatures have six legs instead of eight.

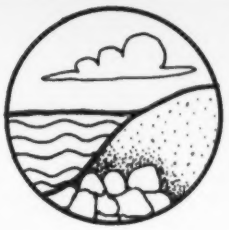
Activity 9
On-site Review

Follow the procedure for the sea shell trip--Unit Six, Activity 13.

Gather litter and collect equipment.

Share memories.

Unit Ten
Field Trip Follow-up and Review Activities



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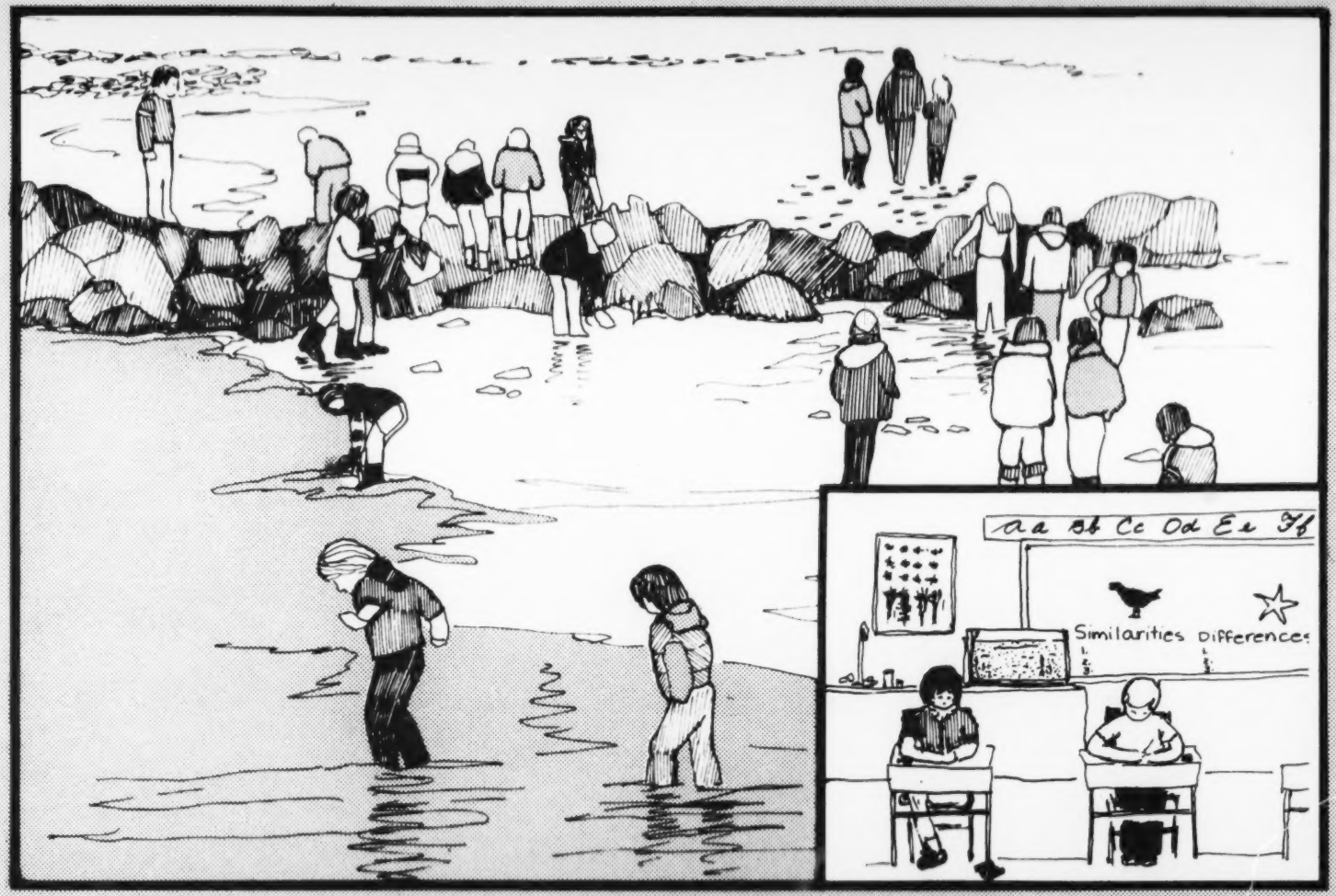
Objectives

To help students:

- Review the field activities (Activities 1, 4).
- Link the field experiences to pre-trip classroom work (Activities 1, 10, 12, 14).
- Use the field experience as the stimulus for language arts, music and art activities (Activities 1, 2, 3, 4, 5, 6, 7, 8, 9, 10).
- Recall the different groups of mollusks and insects (Activities 13, 15).
- Appreciate the enrichment water invertebrates add to their local environments (Activities 1, 2, 8, 15, 16).



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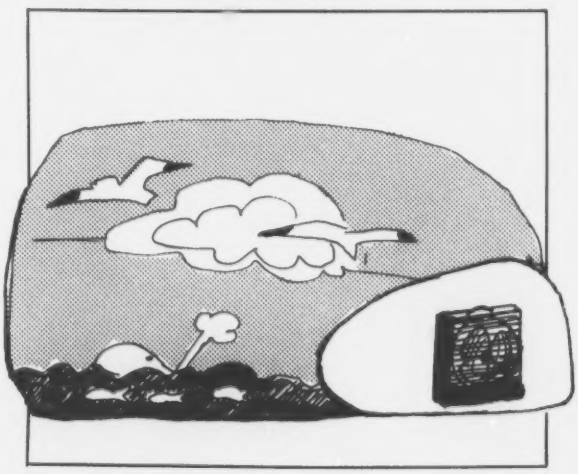
Unit Ten: Field Trip Follow-up and Review. This unit is designed to transfer the understandings gained in the field to the classroom curriculum, using interest generated by field experiences to stimulate classroom lessons.

The field trip, as an ideal culmination of Sea Week studies, is also an ideal takeoff point in itself for further learning in the classroom. Thus, the following review activities are so designed, facilitating lessons across several subject areas: art, science and math, language arts and music.

Activity 1
Create a Habitat - Bubble Room or "Magic Submarine"



Background:

This activity simulates several different habitats in an underwater environment. As an artificial "immersion," it can be used to either stimulate creative activities or function as a retreat for a special reward.

If a "bubble room" is not possible, experiment with large cardboard boxes, or use a loft, hallway, or the corner of a classroom. Bubble rooms are special places with magical appeal.

Materials:

- three-inch wide duct tape or strapping tape (not masking tape)
- 50-foot roll of six-foot wide, .004-weight clear plastic
- acrylic paint (comes out of clothes with rubbing alcohol)
- paint brushes
- drawing or manila paper
- crayons
- scissors

- scotch tape
- waxed paper
- window fan
- worksheet: ...Organisms in Their Habitats (10A)

Vocabulary:

- habitat
- bottom
- top
- sides
- organisms

Procedure:

1. Bubble rooms can be designed in many fashions. The following is among the simpler layouts.

   Lay three pieces of six- by 12-foot clear plastic side-by-side on the floor. Tape the edges together where they touch.

   Pull one 12-foot side across to the other edge. Tape these together. At this point, you should have a 12-foot tube, open at both ends.

   Cut a new piece of plastic into a three- by six-foot rectangle to match the end of the tube. Close one end of the tube by placing the new length of plastic across the opening.

   Place a sturdy window fan in the other end. Turn it on to inflate the bubble. Have students crawl past the fan. Once they're in, temporarily seal the plastic around the fan using clothes pins or masking tape.

2. Brainstorm plans for bubble-room artwork:

   What was on the bottom?
   What was on the surface?
   What was on the edges?
   What is in the open water?
   What changes would occur if you traveled from a pond to the ocean?

3. Have students choose items they want to see from the bubble room. Instruct them to draw a picture of the object on paper. These patterns are then either taped on the top and sides, or placed underneath the bubble for students to copy onto the bubble with paint. As their confidence increases, they might want to delete the patterns and paint directly onto the bubble. Leave one area blank as a viewing screen.

   NOTE: Patterns may be taped inside or out. Items that ordinarily would be out of the water--such as clouds, flying gulls, or water lily blossoms--appear more realistic if they are painted on the outside.

4. Picture suggestions:

   Pond:

   Top: bottom of a duck, fish, swimming beaver, duckweed roots, water strider.

   Sides: beaver dam, otter slide, fish, water boatman, beetle, stems.

   Bottom: clams, bottom fish, rocks, mud, litter.

   Ocean:

   Top: bottom of boat, bottom of an iceberg or float, bottom

of gull, duck or sea bird, sea otter, whale.

Sides: seal, whale, fish, octopus, ship wreck, rocks, algae.

Bottom: shells, bottom fish, rocks, litter.

5. Construction hints: Painting is best done on an inflated bubble. Painting outdoors can prove quite successful. Waxed paper makes an excellent paint-mixing palette for each child. Acrylics stick to the plastic, but eventually may begin to peel. It can be cleaned off and the bubble room recycled as another habitat or for other uses. Heavy plastic cannot smother children if accidently deflated. However, do not use light-weight materials.

6. Now your bubble is ready to use to further stimulate creativity. Expand the bubble environment to include auditory as well as visual experience by playing tapes of appropriate music: sea chanties, loon cries, song of the bearded seal, song of the humpback whale, sounds of surf, water dripping. Write poetry inside. Sing songs inside such as "Mud, Mud, Mud" by Good Apple Press. Write stories about living under water or being transformed into a predacious diving beetle (see Ghost boat by Jacqueline Jackson), or being a good fish in a bowl. Have a class storyhour inside, reading water legends or adventures. Design a bubble room home for people living at the bottom of ponds or oceans. Be sure to include air locks. (Contributed by Gerry Young, University Park Elementary, Fairbanks)

7. The magic submarine also can be used as a media bubble. Leave a viewing window blank when you paint your submarine. Show your favorite underwater movie or slides on the bubble from outside and view on the inside. Students can also create a water experience for their classmates inside the bubble, by mixing water, food coloring and oil in a glass pan on an overhead projector focused on the side of the bubble. Insects in petri dishes projected from the overhead will squirm and swim on the side of the submarine. (Contributed by Linda Bode, Koyuk Malemute School, Koyuk)

8. Use the Organisms in their Habitats worksheet to review habitats.

Activity 2
Sand Painting

Materials:

- sand (from field trip)
- bucket or dishpan
- dried tempera or printer's ink
- oven (optional)
- sprinkler (optional)
- paper
- pencil or crayon
- glue (such as Elmer's)

Procedure:

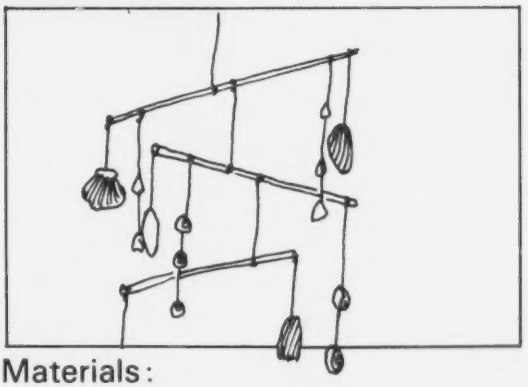
1. Collect sand from the beach and prepare it for painting: Strain it. For a half-hour, soak the sand in printer's ink or dried tempera, mixed in a strong solution of rubbing alcohol. Dry sand.

2. Have students draw pictures of shells on paper, then put glue on the drawing for one color of their picture.

3. Put one color of sand in a sprinkler. Allow students to sprinkle the glue with sand from the sprinkler or with their fingers. Let the glue dry, then dust off the excess sand.

4. Repeat steps 2 and 3 for additional colors.

Activity 3
Shell Mobile



Materials:

- thread, fishing line or dental floss
- supports: dowels, coat-hanger wire, or pieces of driftwood
- variety of shells (from field trip)
- white glue
- electric drill with small bit, or hand drill, or hammer and small nail.

Vocabulary:

- balance
- names of shells chosen
- mobile

Procedure:

1. Make a hole in each of the shells with an electric drill. This is time consuming. Most teachers prefer to drill the holes before class.

2. Tie thread, fishing line or dental floss to the shells.

3. Cut a support to the desired length. Suspend the threaded shell from the end of it.

4. Add as many balancing parts to the mobile as time and imagination allow.

Additional Art Activities:

1. Make a collage of life on the bottom of a pond or tide pool.

2. Make a picture of an insect, shell, beach or pond, using only natural materials.

3. Have students illustrate the "Young Raven" song in Activity 10.

4. Have students draw shells or insects, labeling them with their common names. Then have them add a new name of their own invention.

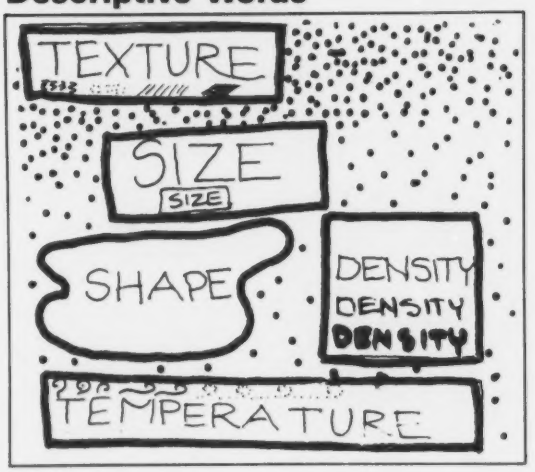
5. Make crayon resist sea creatures.

6. Make water color seascapes.

7. Make collage seascapes, using real sea or beach objects with crayon and paint.

8. Make shell pins by gluing safety pins to the back of shells.

Activity 4
Descriptive Words



Materials:

- objects found on the shores of an ocean or pond (These will be used to illustrate texture, size, shape, density and temperature. Representative objects include shells, sand, driftwood, stones, moss, water, plants, birds, clouds, sunlight.)
- task cards described below

Vocabulary:

- description
- texture
- shape
- size
- density
- temperature

Procedure:

1. Discuss description and words used to describe objects. Introduce students to the major category headings: texture, shape, density, temperature and size, using examples from the classroom to illustrate.

2. Divide the class into small groups. Give each group cards with the following questions:

   - What do you see with a texture that could be described as slick? Hard? Rough? Soft? Slimy? Velvety? Coarse? Knobbed? Furry? Hairy? Waxy?

   - What do you see with a shape that could be described as round? Oblong? Triangular, Rectangular? Pointed? Curved? What other words describe the shapes of these objects?

   - What do you see with a density that could be described as solid? Hollow? Spongy? Porous? Nonporous? What other density words describe the objects?

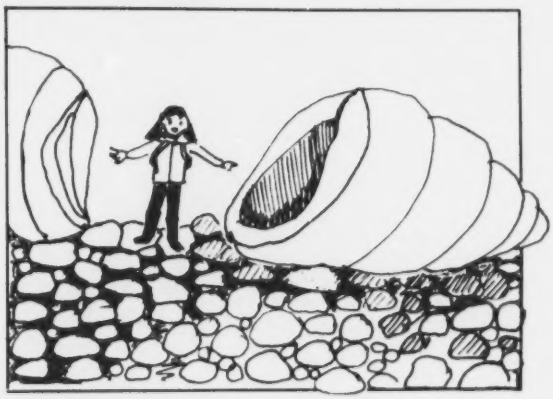
   - What do you see with a temperature that could be described as hot? Cold? Clammy? Cool? Lukewarm? What other temperature words describe the objects?

   - What do you see with a size that could be described as narrow? Large? Small? Tall? Short? Thick? Heavy? Bulky? What other words describe the sizes of objects?

3. Have the groups work through the task cards.

4. For review at the end of the period, assign each group a task card or part of a task card to present to the rest of the class.

Activity 5
Water Stories



Procedure:

Use the following "Story Starters" to initiate stories in class. Either have students complete the stories on their own, or pass the story from student to student. Here are some "starters":

Suddenly, before my eyes, the shell began to grow.

My dog began barking fiercely at the strange creature that was floating toward shore.

I was beachcombing [or exploring a pond] one foggy afternoon and suddenly bumped into a....

The frothy wave leaped up onto the dock and carried me away on its crest.

I always thought sea monsters were make believe until....

I was slowly opening the clam shell and to my great amazement discovered....

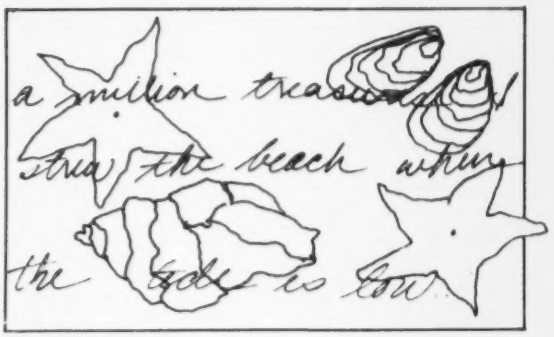
As I was wiggling my toes in the sand, my foot struck something strange.

I was studying this bivalve shell, when suddenly it moved its two halves and said...

I was exploring a beach [or pond] one rainy afternoon when I suddenly began to shrink! Soon I was the size of a [periwinkle, snail, etc.].

I find the inside of a univalve shell the most wonderful home because...

Activity 6
Sharing Poetry



Background:

Poetry links the natural world with language arts and also can help express values and feelings. The addition of poetry to Sea Week provides the opportunity to develop articulation and verbalization skills.

Materials:

- felt-tip pens
- large format paper

Vocabulary:

- poetry
- rhyme
- selected words from poems used in class

Procedure:

1. Have the poems on large format paper for group visibility.

2. Either read the poems to the class or have individual students read them orally.

3. Have the class memorize parts or all of a poem.

4. Have students illustrate a poem.

5. Write and add lines or change phrases, substituting either Alaska situations in general, or specific inspirations from the field trips.

Sea Shell

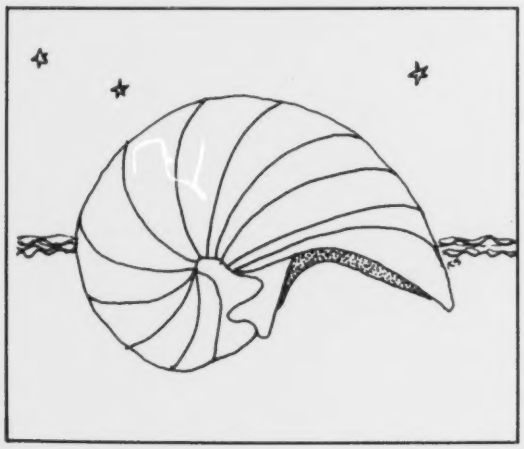
Sea shell, sea shell
Sing me a song, O please!
A song of ships and sailor men,
And parrots and tropical trees,

Of islands lost in the Spanish Main,
Which no man ever may find again,
Of fishes and corals under the waves,
And sea horses stabled in great green caves.

Sea shell, Sea shell,
Sing of the things you know so well.

--Amy Lowell

("Sea Shell" by Amy Lowell is from Domes of Many-Coloured Glass, published by Houghton Mifflin. Reprinted by permission.)



I took away the ocean once
Spiraled in a shell
And happily for months and months
I heard it very well
How is it that I should hear
What months and months before
Had blown upon me sad and clear
Down by the grainy shore.

--David McCord

(The above poem by David McCord is from One at a Time, published by Little, Brown. Reprinted by permission.)

The Snail

Little snail, little snail,
with your hard, stony bed,
First stick out your horns,
then stick out your head.

Oh, where is the little snail gone, I pray tell?
He has drawn himself up, head and horns, in his shell.

--Isaac Taylor Headland

("The Snail" by Isaac Taylor Headland is from Chinese Mother Goose, published by FLeming H. Revell, Co. Reprinted by permission.)

Creatures

see here the diving beetle is
split
flat on the underside like a
peach pit

and Kindergarten blue the
frail
biplanes of dragonflies touch
head to tail

and water measures on jury-
rigged
legs--dent the surface film
and whirligigs

crowblack and paddle-footed
spin
clock-wise and counter-
somehow locked

in circus circles and back-
swimmers all
trim as college racing
shells

row trailing their four eyes
upside down
and mayflies seek the under-
sides of stones

to squirt their eggs in rows
as straight as corn
and only after clamber out to
drown

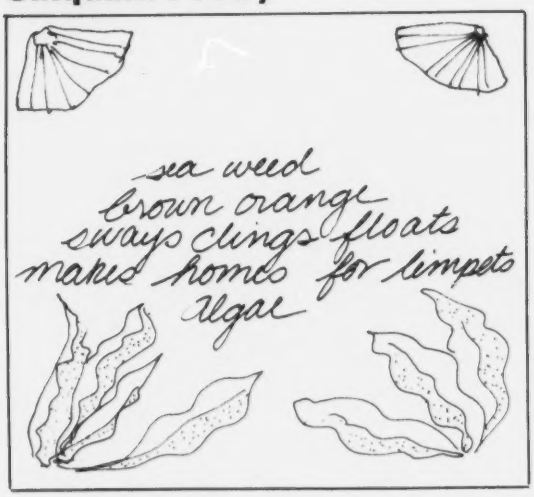
and pond's stillness nippled
as it
by rain instead is pocked
with life

and all, all except the black
horse leech
let pass my entering pale
enormous
flesh.

--Maxine Kumin

("Creatures" by Maxine Kumin is from Up Country, published by Harper and Row. Reprinted by permission.)

Activity 7
Cinquain Poetry



Background:

Cinquain is a form of Japanese verse. The Japanese construct their poems by numbering syllables. The following is a simplified version for use with your students. On completion, they will have created a simple five-line poem about their favorite shell.

Materials:

- pencils
- paper or cinquain worksheets

Vocabulary:

- cinquain
- describe
- doing
- phrase

Procedure:

1. Making a simple worksheet with blank spaces for each word will ease the instructions for your students.

2. Split the class into small groups or work as a class.

3. Instruct the students to fill in the lines as follows:

   A. On line one, write the name of your favorite shell (or favorite part of Sea Week).

   B. On line two, write two words describing the subject.

   C. On line three, write three words that tell what the subject does, or is doing.

   D. On line four, write a short phrase about the subject.

   E. On line five, write a word that means the same thing as the word or words on line one.

4. Ask students to volunteer to share their poems with the class.

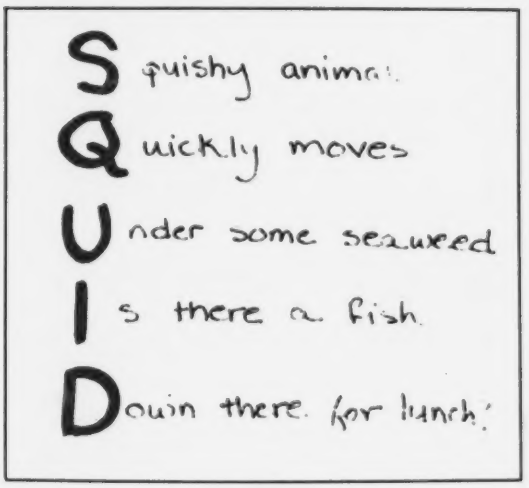
   Example:

   Shore
   Sandy stormy
   Hisses, splashes, rests
   Changes with the ocean
   Beach

   Seaweed
   Brown orange
   Sways clings floats
   Makes homes for limpets
   Algae

(By Britta Weller, Gery Young's class, University Park Elementary, Fairbanks)

Activity 8
Water Creature Poetry



Materials:

- pencil
- paper

Procedure:

1. Have each child select a mollusk or insect.

2. Now have them write the animal's name from top to bottom down the left-hand margin of their paper.

3. Ask them to write a sentence beginning with each letter of the animal's name.

   Example:

   Collect them carefully at the beach.
   Look at the shell, inside and out.
   Are you going to eat one?
   M-m-m-m! It was good.

   These "poems" can easily be compiled into a class book.

Activity 9
Thank You Letters

Dear Mrs Grant,
Thank you for coming with us to sandy pond on Tuesday. We had fun and learned a lot.
From,
miss Wells' 2nd grade

Materials:

- pencil
- paper

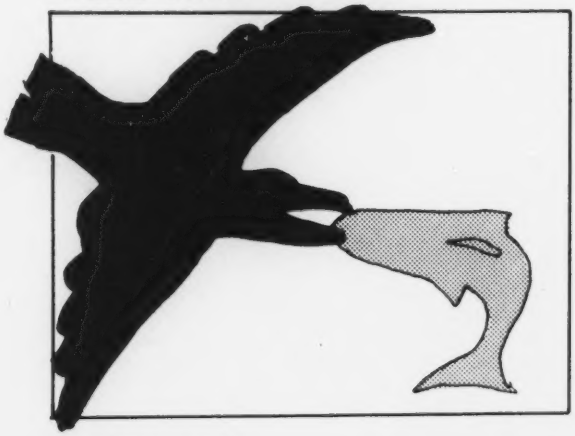
Procedure:

1. Have the class write letters to all support personnel who went on the field trip.

2. Have the class help you make a list of people who should be thanked. Then let them decide the most appropriate thank you. Drawings or art projects could accompany letters as a special thank you.

3. Divide the letter writing and craft responsibilities for each thank you among student volunteers.

Activity 10
"There Was A Young Raven" - Food Chain



Background:

Songs can teach food chain concepts. The following song is sung to the tune of "There was an Old Lady Who Swallowed a Fly." After learning the song, discuss whether a raven is adapted to eat a bear.

In this activity students will begin to recognize the connection between animals and their food sources. Other post-trip activities deal with the complete food web.

Materials:

- There was a Young Raven" song
- worksheets:
  - ...Insect Word Search (10B)
  - ...Bivalve Word Search (10C)
  - ...Mollusk Word Search (10D)
  - ...Mollusk Crossword (10K)
  - ...Sea Week Puzzle (10L)

Vocabulary:

- predator
- prey
- plankton
- adaptation

Procedure:

1. Teach the class the following song:

There was a young raven who swallowed a mayfly
I don't why, she swallowed the fly
Perhaps she'll die.

There was a young raven who swallowed a water strider
That wiggled and swiggled and tickled inside her.
She swallowed the strider to catch the fly
I don't know why she swallowed the fly
Perhaps she'll die.

There was a young raven who swallowed a frog.
What a hog, she swallowed a frog.
She swallowed the frog to catch the strider.
That wiggled and swiggled and tickled inside her.
She swallowed the strider to catch the fly.
I don't know why she swallowed the fly
Perhaps she'll die.

There was a young raven who swallowed a fish
Without a dish, she swallowed a fish
She swallowed the fish to catch the frog
She swallowed the frog to catch the strider.
That wiggle and swiggled and tickled inside her.
She swallowed the strider to catch the fly.
I don't know why she swallowed the fly.
Perhaps she'll die.

There was a young raven who swallowed an otter
She teetered and tottered and swallowed that otter
She swallowed the otter to catch the fish
She swallowed the fish to catch the frog
She swallowed the frog to catch the strider
That wiggled and swiggled and tickled inside her.
She swallowed the strider to catch the fly.
I don't know why she swallowed the fly.
Perhaps she'll die.

There was a young raven who swallowed a bear.
She died right there.

2. Rewrite the "Young Raven" song using saltwater organisms or organisms found on your field trip.

3. Discuss students' individual eating habits, as well as their preferences for certain foods. For example, some may prefer meats, whereas others may prefer plant foods such as vegetables or fruit. Similarly, insects and mollusks also have their own food preferences.

4. List the foods insects eat. Insects eat plants (live, dead, algae) or capture insects and other small animals, or collect the plankton floating in the water.

5. List the foods mollusks eat. Mollusks eat other mollusks, plankton and algae, and octopus even eat crab.

ADDITIONAL LANGUAGE ARTS ACTIVITIES

Use water-related words for a spelling list, including shell or insect names and parts, the name of the beach you visited, types of weather you encountered, and other words that students will associate with their Sea Week experiences.

Have the class copy the following sentences from the board. Have them choose one insect or mollusk to be, and have them then complete the following sentences.

I am _____.

I look like _____.

I live _____.

Begin the activity with a class discussion of the ocean--its ecological balances, pollution, and other subjects. To end the activity, have each student complete this sentence: "Hi! My name is Lonnie Limpet. The ocean is worth saving forever because _____."

Listen to a recording of "La Mer" by Claude Debussy. Discuss what it would be like to be a shelled animal living in the sea. As a contrast, listen to Richard Rodgers' "Victory at Sea," and use it as a basis for discussing the sea's different moods.

Make shell grab bags. Place one shell in each bag. With student help, create a list of descriptive words. One at a time, have students put a hand in a bag without looking, and either a) name the object, b) describe the object with descriptive words and have the class guess what it is from the description, or c) play "Twenty Questions," having the class ask descriptive questions about the object.

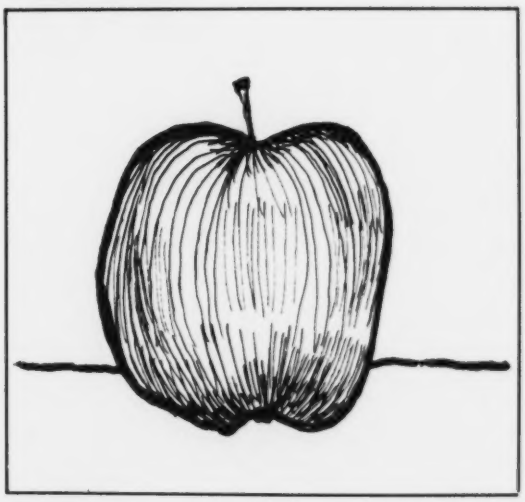
Use the Insect Word Search (10B), Bivalve Word Search (10C), Mollusk Word Search (10D), Mollusk Crossword (10K) and Sea Week Puzzle (10L) worksheets to review terms.

Write "Tongue Twisters" such as "She sells seashells by the seashore."

Ask students to write a story about a day in the life of their favorite invertebrate.

Design a button about shells (ideas: beauty of shells, uses of shells, "catchy" sayings).

Activity 11
Food chain



Materials:

- butcher paper
- crayons
- construction paper
- tape or glue
- scissors

Vocabulary:

- food chain

1. With students, make a cross-section mural of your field trip. Place mollusks or insects on the mural where students found them.

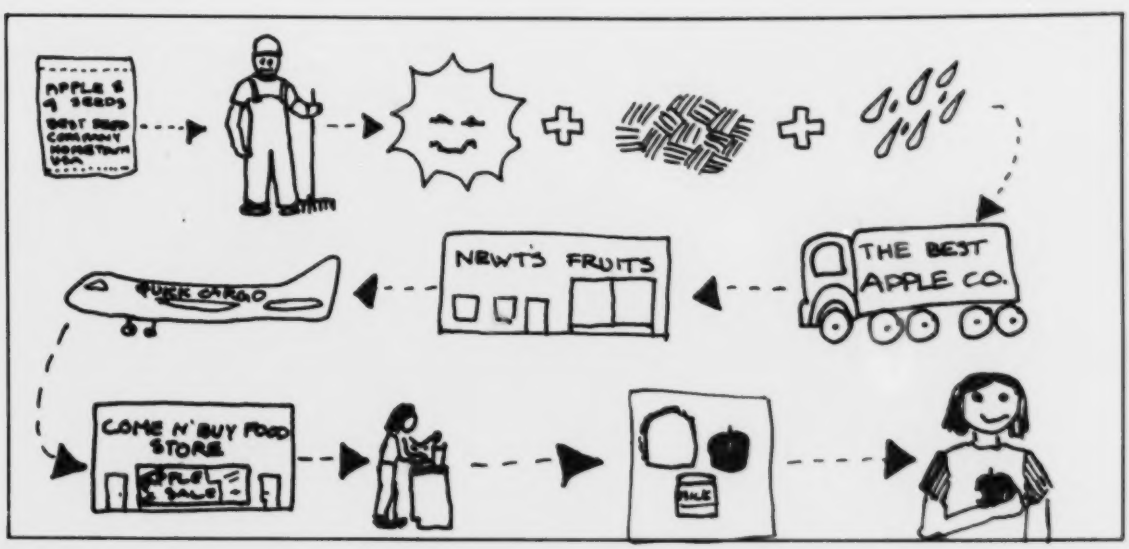
2. Using either the cross-section mural or new student illustrations of water creatures, construct a food chain of the interaction at your site.

3. Barn swallows collect 900 insects per day to feed their babies. Insert barn swallows and mosquitoes in your food chain. Have students list other possible beneficial characteristics of mosquitoes.

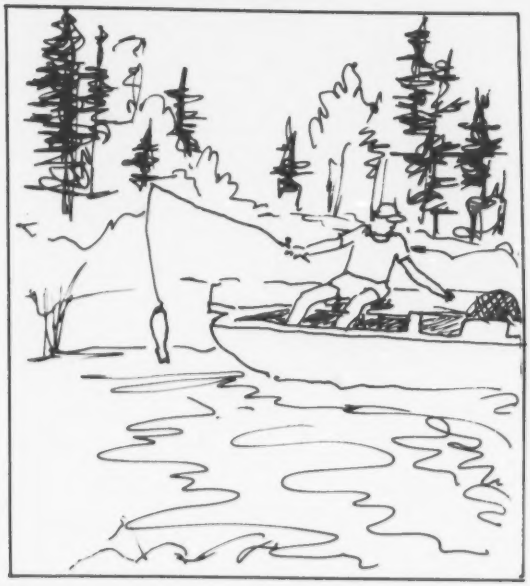
4. Have students create a food chain for a food item they consume.

   Example: apple

   Seed company - farmer - sun, soil, water - truck - fruit company - airplane - grocery store - parents - lunch - student.



Activity 12
To Catch A Fish - Predator-Prey Relationships



Background:

Fish eat insects and people eat fish. People have understood this simple food chain for a long time and take advantage of this understanding to create the sport of fly fishing.

Fly fishing, as well as fly tying, is a popular sport and an ancient art. The first book on fly fishing was published in England in the 1600s. It was written by Dame Julianna Berners, lady prioress of Britain's Sopwell Nunnery. Its title was "A Treaty on Fysshing With an Angle." The most famous early book on fly fishing, however, was written about 150 years later during the Eighteenth Century by Izaak Walton, now famous as a conservationist. Walton's book, which is still widely published, is titled "The Compleat Angler." The "fly" used in fly fishing imitates one of the freshwater insects, usually either a caddis fly, mayfly or stonefly. These insects are important and popular food sources of freshwater fish. Fishing people try to imitate the appearances of these insects with bits of fur, feathers and other materials tied with string to a hook. They then try to recreate the behavior of the insects by placing their facsimiles lightly on the water surface or dangling them below the surface. Alaskans fly fish for grayling and trout in streams and rivers. The same strategy is used in most sport fishing. The popular pixie lure, for instance, imitates the flash of a small fish in the water. Fish also are always on the lookout for one of their favorite foods, the red roe of salmon. People who make flies have learned this and often include little bits of red to catch the eye of the fish.

There may be a fly fisher in your community who could visit your class to explain the craft and show students some "flies." If you live in an area with a sports or fishing store, they may be able to either lend you some flies, have one of their staff visit, or be able to recommend a fly fisher in your community.

Materials:

- reproduction of fishing fly pictures
- fishing flies (optional)
- pencil
- paper
- worksheet:
  ...Fish Flies (10E)

Vocabulary:

- food chain
- fly fishing
- lure
- predator
- prey

Procedure:

1. Ask how many students eat fish. Where do they get their fish? Where did the fish originally come from? What are the habitats of some of the fish they eat? On the board, draw a picture of a fish and a person, with an arrow between the two.

2. Ask students what that fish ate. (e.g., another small fish) Then ask what the food of the fish ate. Draw each addition to the food chain and continue the questioning until you have all the components of a food chain on the board. The final organic component should be a plant (If you get into the plankton line, the animal plankton eat plant plankton). Remind students that all plants require water, air and sunshine.

3. Explain to students that the picture on the board is a food chain because all the animals and plants are linked together by what they eat.

4. Discuss with students the ways people get fish--trap them in nets, catch them with worms or other bait, or otherwise trick them into biting a hook or a lure. Who has ever fished with lures? What did the lure look like?

5. If students are not familiar with fly fishing, remind them that fish eat insects, so some people try to copy insects to catch fish. Show them the pictures of either the fishing flies or the actual flies. Use the worksheet and have them identify the aquatic flies copied by people who fly fish.

6. Next have them create a fly that would catch an Alaskan fish. They can either draw a picture of their fly or use construction paper and art scraps to construct one.

7. Brainstorm with your students what other animals might be caught with lures (these demonstrate predator-prey relationships).

   Examples:

   A Little Red Riding Hood lure would catch a Big Bad Wolf.

   Princess lures catch dragons.

   Merchant ship lures catch pirates.

   Ahab, Jonah or Pinochio lures catch whales.

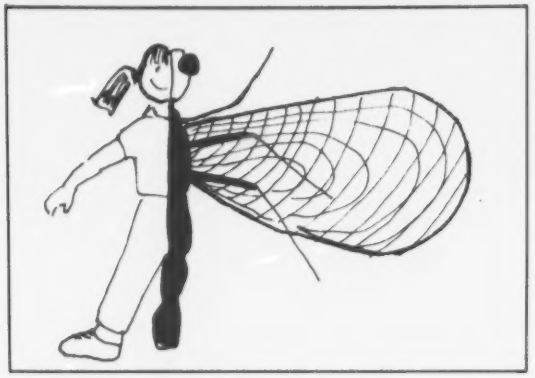
   Green willow sapling lures catch beavers.

   Pac Man lures catch teen-agers.

9. Make a mobile to illustrate as many lures as the students can imagine.

10. Have students research what the Native people of their community use to attract fish.

Activity 13
Insect and Mollusk Review



Materials:

- shell or insect specimens from field trip or class collection
- scissors (optional)
- worksheets:
  - ...Mollusks and Insect Squares (10F)
  - ...Insect Concentration (10G)
  - ...Color the Mollusk Review (10H)
  - ...Mollusk Matching (10I)

Vocabulary:

- similarities
- differences
- mollusk
- insect

Procedure:

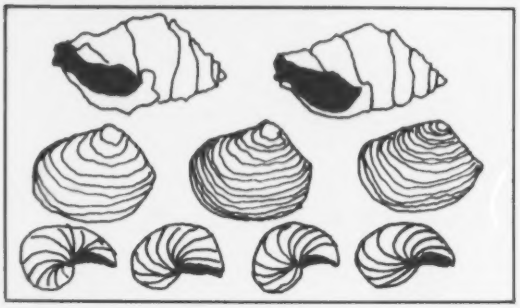
1. Review invertebrates with the class. Remind students that mollusks and insects are both groups of invertebrates. Discuss the similarities and the differences of one they have found previously or now have in class.

2. Break the class into small groups. Instruct the groups to separate the blocks on the Mollusks and Insect Squares worksheet. Have each group find the two heading squares: Insects and Mollusks. Next have the class work with their group, and split the remaining squares between those two categories. Finally, check students' placement of squares, then have them explain why they put them there.

3. Ask students: if a person was to turn into an insect, what would have to change? (Get two more legs/arms attached to thorax, grow wings, lose bones and get a hard skin.) Repeat the questions with mollusks. Ask students to draw either themselves or a famous person to resemble an insect or mollusk (Captain Cook Dragonfly, Ulysses S. Grant Stonefly or Venus Scallop).

4. Use the Color the Mollusk Review and Mollusk Matching worksheets and Insect Concentration Game to review mollusks and insects.

Activity 14
Shell Treasure Hunt



Materials:

- samples of a variety of shells
- pencil
- worksheet:
  ...Treasure Hunt (10J)

Vocabulary:

- bivalve
- univalve
- tough, smooth
- old
- new
- drilled
- large
- small

Procedure:

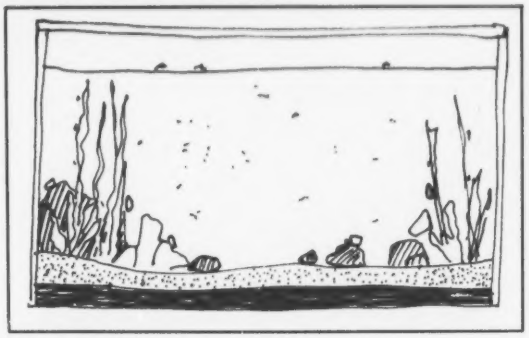
1. Distribute the shells throughout the classroom so students do not have to crowd.

2. Review the names of each shell, or label the shells with their names.

3. Use the Treasure Hunt worksheet to initiate student observations. Part of that sheet has been left blank so you can add questions you would like to ask.

4. After students have filled the sheet, review and have them justify their responses.

Activity 15
Classroom Activities With Live Insects



Materials:

- aquarium or gallon jars
- scraps of meat for food
- jars
- water plants and litter
- food coloring
- petri dish
- India ink or food coloring
- overhead projector
- yeast
- dropper
- sugar

Vocabulary:

- temperature
- water level
- records
- food preference
- prey
- predator
- chase
- ambush
- grab
- bite

Procedure:

1. To keep the animals for long-term study, set up an aquarium. For detailed instructions, see the source book. If you plan to keep them only a few days, place them in the refrigerator,

replacing their water with fresh water at regular intervals. Be sure to release the insects to their original homes when your studies are complete.

2. The aquarium is a good place to observe interactions and see the drama of life played out. Students can watch insects chase each other, eat plants, or change from immature to adult. Even with close observations, you will miss much of the interaction that takes place. Keeping records will provide you with clues through which to work out the mysteries. Count the number of organisms put into the tank and record the number daily. Any change in number will indicate the births or deaths of individuals, and will provide clues to the dynamics of your system. Keep records of temperatures and water levels for future reference.

3. When feeding organisms, see what they like best. Is the most basic preference choice plant or animal? Do the vegetation eaters prefer dead leaves found in their original homes? Live water plants? Live leaves from trees? Lettuce? Something else? Try a variety of foods for the animal eaters, too. Which insects eat the most? The least?

4. Add mosquito larvae or pupae (or other easily gathered insect prey) to the aquarium. Keep a count and keep a cover on the aquarium so you can keep track of how many hatch. Watch to see who eats the most. Try another prey and see if the same predator is the chief predator. How do the predators catch the prey--chase, ambush, grab, bite? Try keeping the prey constant and varying predators in the system. (Recommended predators: predacious diving beetles, damselflies, dragonflies and water striders.)

5. An overhead projector provides an opportunity for the class to view insect movements as a group without crowding around a pan. Place a live insect in a petri dish or other clean container with just enough water to allow the animal to move. Place the dish on the overhead projector. The light is enough stimulus for action. If the critter crowds the edge of the dish or gets out of the field of view, it can be guided with a pencil or dull probe. Does the insect move its body up and down or from side to side? Does it use legs or other appendages to stroke with? Or does it move by jet propulsion as does the dragonfly? A drop of ink or food coloring will mark the currents created by these movements (See procedure 7 of this activity). Have the class pantomime the moving strategies they witness.

6. Animals that filter their food from the water do not seem to provide drama, action, or concrete experiences for students. This situation can be changed by marking food. Color yeast with India ink or some other insoluable dye. Place your dyed food in with filter feeders. Clear animals, such as some of the small plankton creatures, are the best for this experiment. The more transparent the

creature, the easier it will be to see what is going on. Remove the creatures from the water, and look for the dyed food in their digestive tracts under a microscope.

7. Insects create currents in the water for a number of different functions, such as breathing, swimming and feeding. Students can trace these currents with a drop of food coloring or ink. Each student, or group of students, should have a petri dish with water and an insect, and a food-color dropper. Have students experiment by dropping drops in various places around the insect--head, tail, abdomen, thorax. What happened? Ask students to hypothesize about the uses of the currents they discover.

8. Remove caddis-fly cases. Provide the naked caddis flies with both natural and synthetic raw materials with which to build cases. Now observe their construction. At which end do they start? How long does it take? What materials do they prefer? Which materials do they refuse?

9. Place plankton in a separate gallon jar aquarium, or purchase some brine shrimp. Keep it in a well-lighted area, but not in direct sunlight. Let students observe the plankton through a microscope or magnifying lens every day. Keep records of temperatures and water levels. Have students periodically draw what they see, trying to identify animals or body parts. Do some organisms disappear, or new ones appear? How does the population change?

10. Separate the same number of plankton into four smaller jars, placing them in different areas of the classroom. On roll paper, list facts about the environment of each jar, such as the number of plankton, temperature, amount of light, and number of times moved by students each day. Students can brainstorm other differences. Observe for a week to 10 days. How does each population differ? Use hand lenses or microscopes to observe.

11. Keep two identical jars at the same spot, but have twice as many organisms in one jar as the other. Record differences in the jar, as in procedure 10.

12. Add a teaspoon of sugar to a jar of plankton. What happens? Can people get too much sugar?

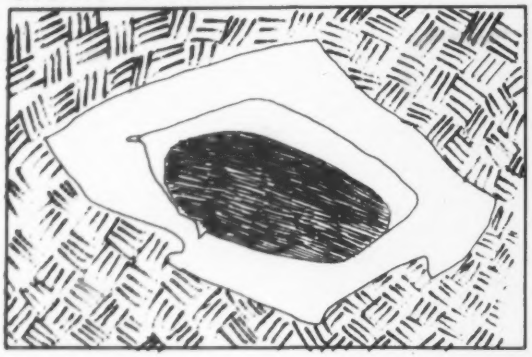
13. What is the plankton's best habitat? What is the best learning environment in the classroom? How would learning be effected by heat or cold, by adding twice as many students, or by removing lights?

14. Use mosquitoes as a focus of study. Place water with mosquito larvae in a screen-covered jar. Keep track of the number of larvae by keeping daily records to follow their life cycle. Draw pictures of them daily. How long do they remain larvae? How long do they stay in the pupal stage? Have someone

volunteer to provide the female her requisite blood meal. Replace her in the jar. Watch for egg-laying behavior. How long from the time the insect draws blood until larvae appear? Ask students to predict how long after a puddle-producing rain there will be a mosquito "outbreak."

(Plankton activities contributed by Gerry Young, University Park Elementary, Fairbanks.)

Activity 16
Create A Pond



Background:

If you do not have easy access to a pond, or even if you do, you can make ponds for study purposes.

Materials:

- shovels
- clear plastic sheeting
- thermometers
- a variety of pond "treatments"

Procedure:

1. Split the class into groups. Have each group create a pond and keep records.

2. Dig shallow, gradually sloping depressions in soft ground. Line the ponds with clear plastic.

3. At this point, the variations begin. Have students add water to their ponds. Some can add tap water, others pond water, stream water or even ocean water.

4. Have each group treat its pond differently. For example, while some can be laissez-faire and leave their

ponds completely alone, others can manage them intensely.

5. In each pond, keep daily records of temperature, turbidity, water level, plant and animal life. What causes the variations? (Sunlight, rain, predation, reproduction, algal growth.) Which pond provides the best plant habitat? The best insect habitat?

6. Possible treatment of ponds include adding soil, adding fertilizer, adding plants, adding animals, covering ponds with clear plastic, covering ponds with dark material.

ADDITIONAL SCIENCE AND MATH ACTIVITIES

Draw a picture of an ideal dragonfly or periwinkle habitat. Tell why it is good for the dragonfly or periwinkle. Draw a picture of the perfect habitat for a person. How does the habitat meet the needs of the person? (Contributed by Gerry Young, University Park Elementary, Fairbanks.)

Start a shell museum in your classroom. Establish rules for handling and displaying shells before the shells start arriving. Set up your museum as a display for the whole school.

Label the shells in your museum with the following information: name of shell, where found, interesting fact about shell.

Draw a bivalve or univalve shell, labeling the important parts.

Create a recipe using an insect as one of the ingredients that an otter or bear might order if these were "fast food" streams.

Design a matching game using the types of insects with the predators that eat them.

Draw an outline map of the pond or stream you visited. Mark areas where fish might seek food and suggest styles of lures for fishing in that pond or stream.

Split the class into groups. Provide each group with a collection of water objects. Ask students to place the objects in groups and then justify their groupings. Possible groupings (classifications) include: shells/not shells, bivalves/univalves, objects once alive/never alive, or color, size, shape or descriptive groups.

What is a shell made of? Put broken bits of shells in vinegar (a weak acid) and observe the reaction. Then try putting chalk, beach sand, gravel, coral, glass, aluminum or other materials into the acid. (Shells are made of calcium carbonate, a base, which will react in the presence of an acid.)

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Compiled by Peggy Cowan, Belle Mickelson, Mary Lou King, and Dr. Earl Clark, associate professor, University of Alaska, Juneau, and his students Joyce M. Roloff, Linda Edmondson, Patricia Muchnick, Dan Penrose, Chris Winter, and Tom Castagnola.

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Somewhat technical. Part of Pictured Key Nature Series. Includes keys to orders and families of insects. Introductory sections on taxonomy, collecting and insects as indicators of pollution.

McCafferty, W. Patrick. Aquatic Entomology. Science Books International, Inc., Boston, 1981. 448 p.

A great deal of taxonomic and ecological information presented from point of view of fly fisher. Beautiful color plates of insect adults and immatures.

Pennak, Robert W. Fresh-water Invertebrates of the United States. The Ronald Press Co., New York, 1953. 769 p.

The standard freshwater invertebrate text. Extensive, detailed keys of all classes of freshwater invertebrates. Much useful information on insect life cycles, habits, collecting and preserving. Line drawings.

Reid, G.K. Pondlife. Golden Press, New York, 1967. 160 p.

The best simplified guide to life in and around ponds and streams. Packed with color drawings. One of the pocket Golden Nature Guide series.

Reid, G.K. and R.D. Wood. Ecology of Inland Waters and Estuaries. D. Van Nostrand, 1976.

Introduction to major principles of aquatic ecology.

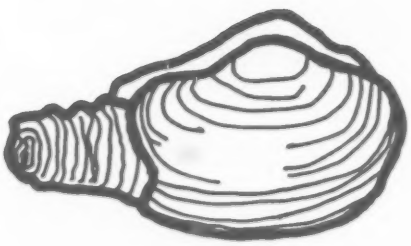
Sisson, Edith A. Nature With Children of All Ages. Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632, 1982. 195 p.

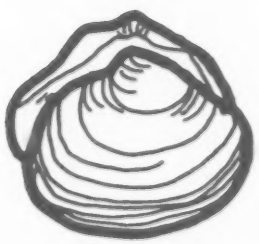
Teaching tips and activities on plants, seeds, trees, invertebrates, fish, amphibians, birds and mammals. Overall guidelines for taking children into the out-of-doors as well as step-by-step plans on specific topics.

Snow, John O. Secrets of Ponds and Lakes. Guy Garrett Publishing Co., Portland, Maine, 1982. 94 p.

Interesting facts and stories written for the East Coast but also applicable to Alaska. Author an avid naturalist and high school biology teacher. Illustrated with line drawings and black-and-white photographs.

Student Activity Sheets





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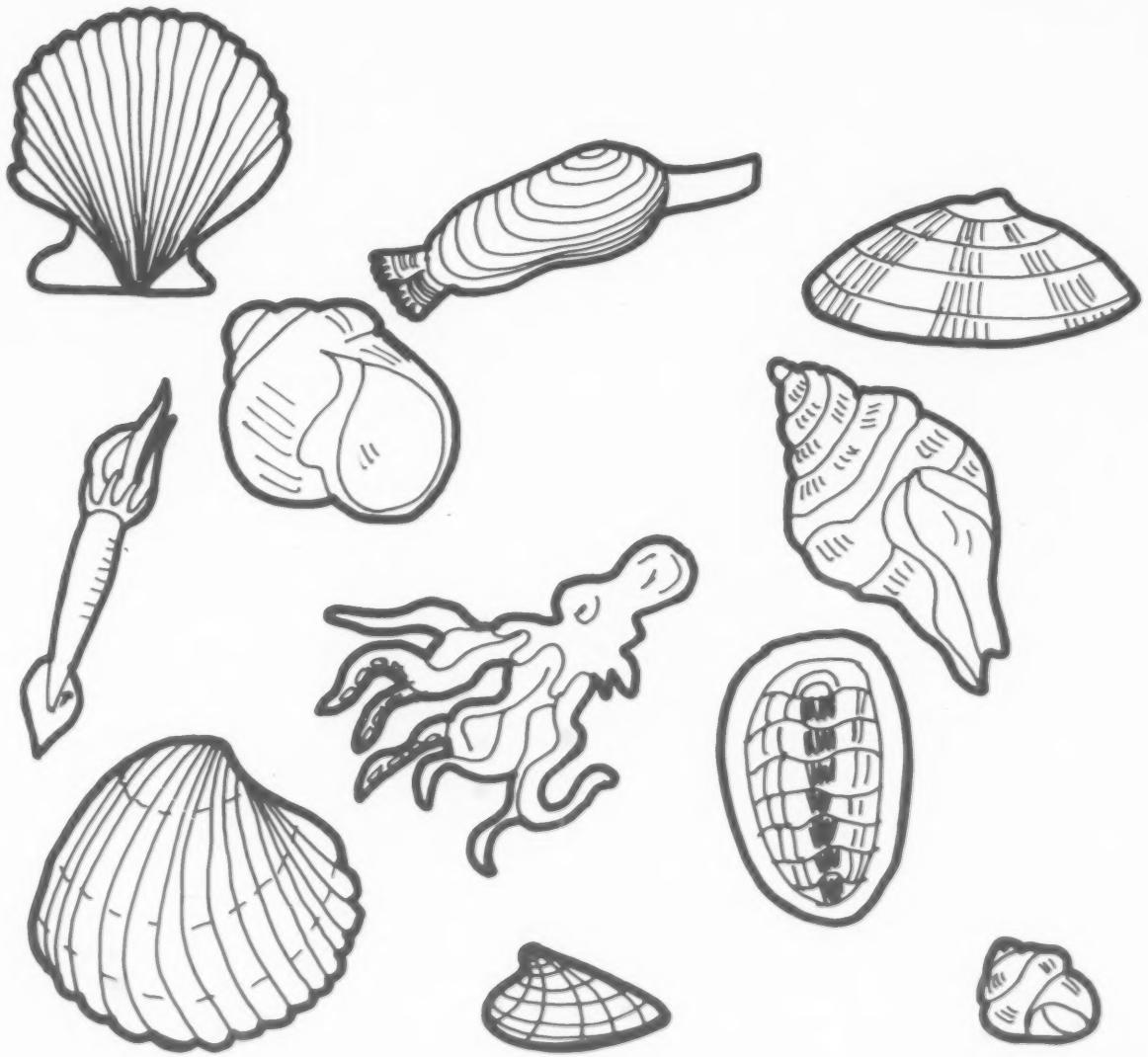
Name: _____

Mollusks

A mollusk is an animal that moves on a big foot.
Usually the body is protected by a hard shell.
These are mollusks.



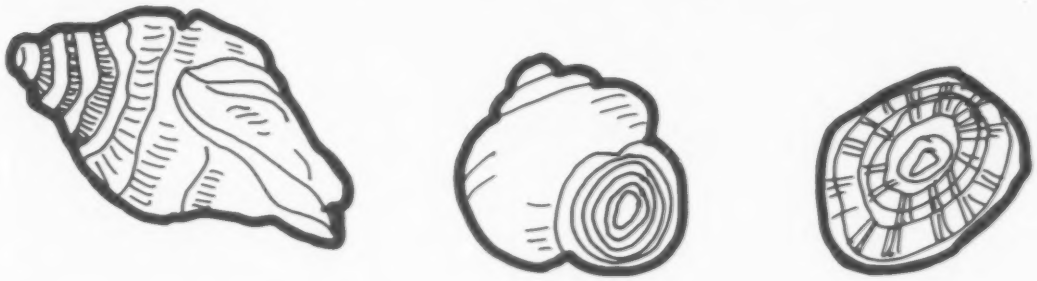
1-B

Name: _____

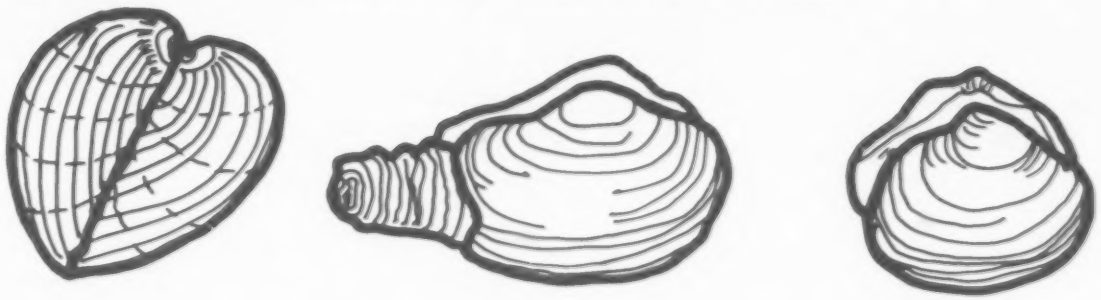
Mollusks Groups

Mollusk (mollusca)
An animal with a soft body often protected by a hard shell.

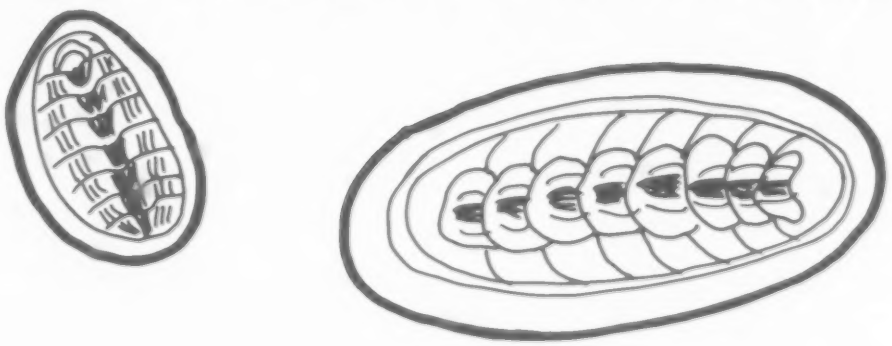
Univalve — This mollusk has only one shell.



Bivalve — This mollusk has two shells.

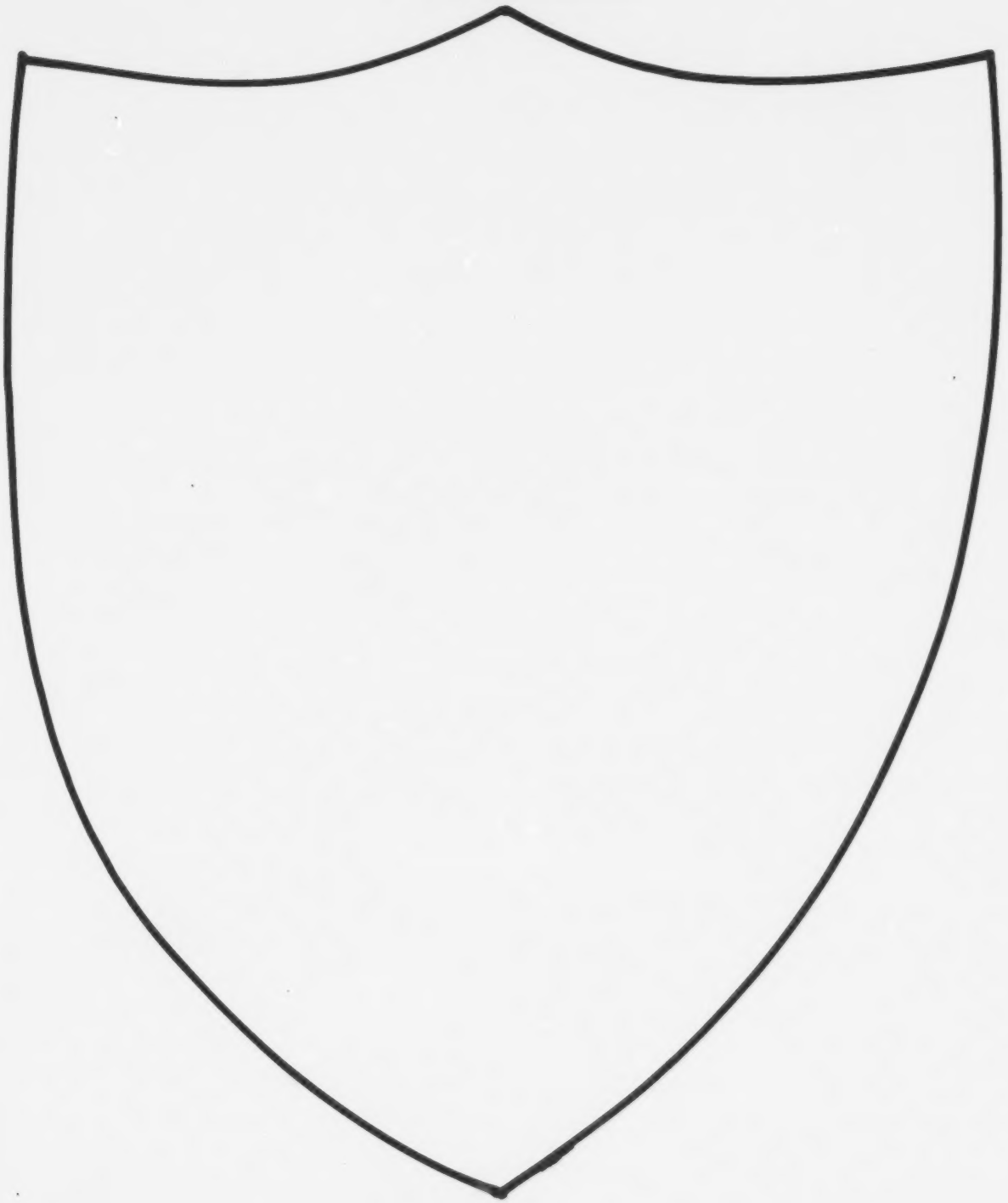


Chiton — A mollusk with 8 parts to its shell.



Name: _____

Coat of Arms



2-A

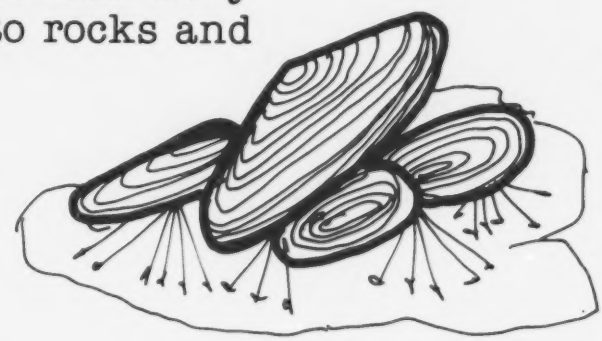
Name: _____

Bivalve vocabulary

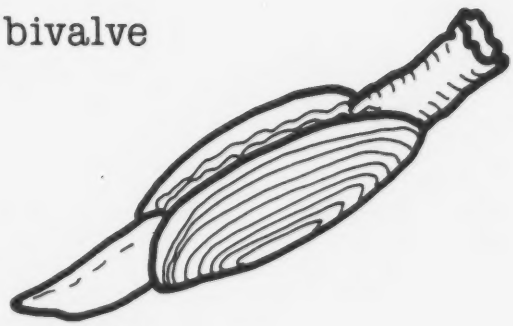
A bivalve is an animal that lives inside a shell. The shell has two parts. The parts are called valves .

Adductor Muscle This muscle opens and closes the shells.

Byssus These look-like threads. They fasten a bivalve to rocks and other things.



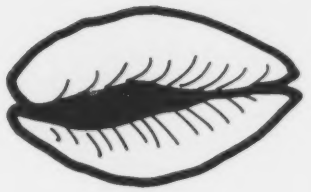
Foot This part helps the bivalve move and dig.



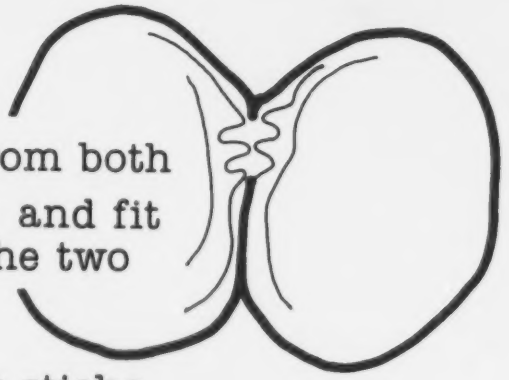
Name: _____

Bivalve vocabulary

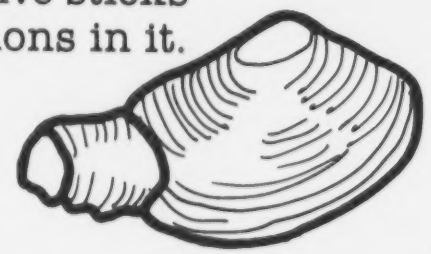
Hinge Ligament — This ligament helps the hinge teeth hold the two shells together.



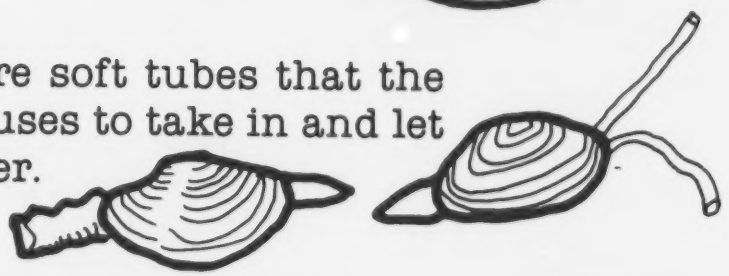
Hinge Teeth — These stick out from both sides of the shell and fit together to join the two shells.



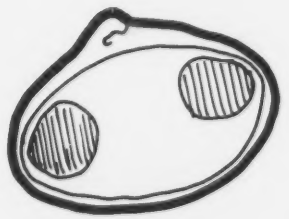
Neck — This part of the bivalve sticks out and has the siphons in it.



Siphons — These are soft tubes that the bivalve uses to take in and let out water.

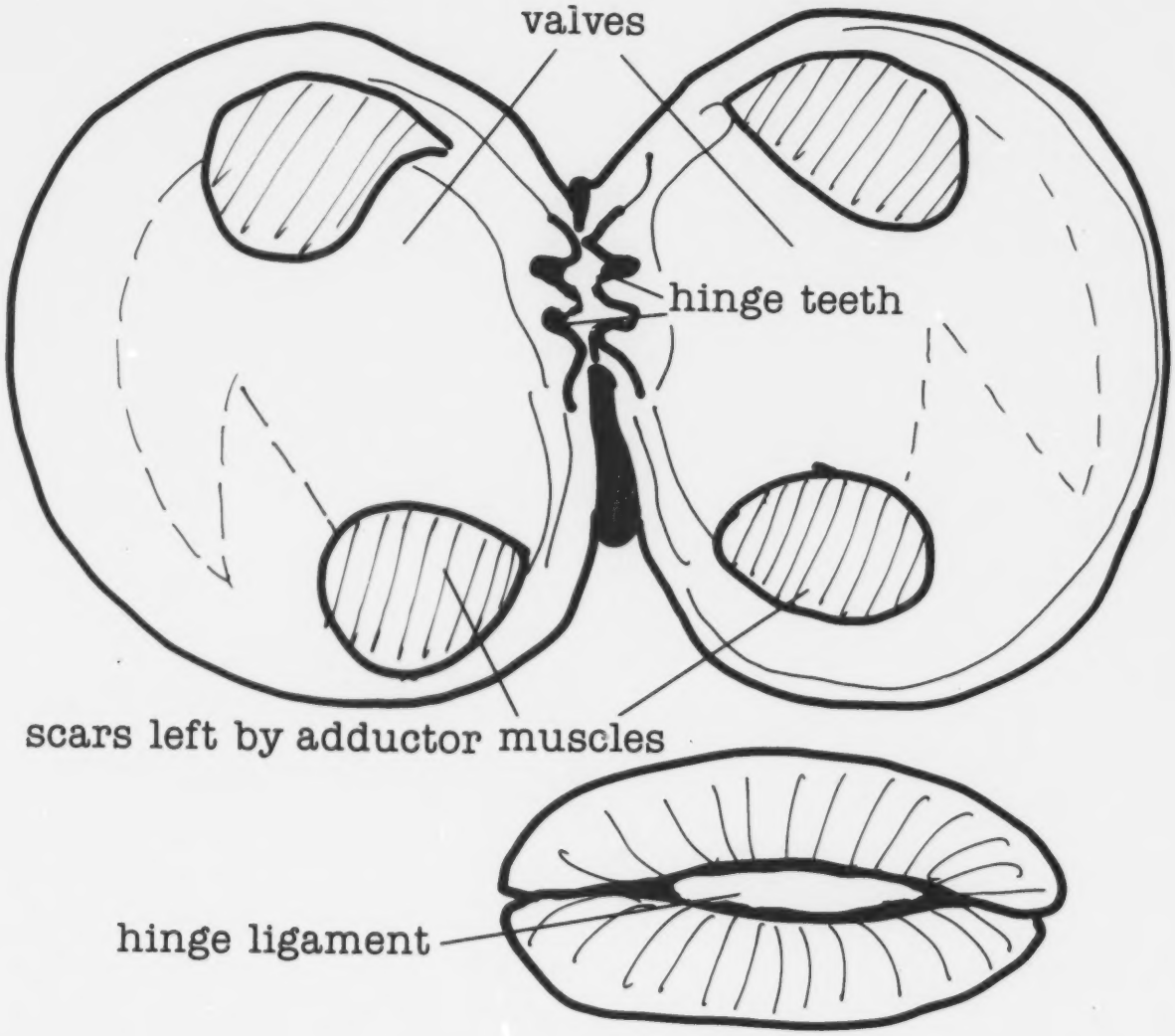


Valve — This is one part of a bivalve shell.



2-B
Name: _____

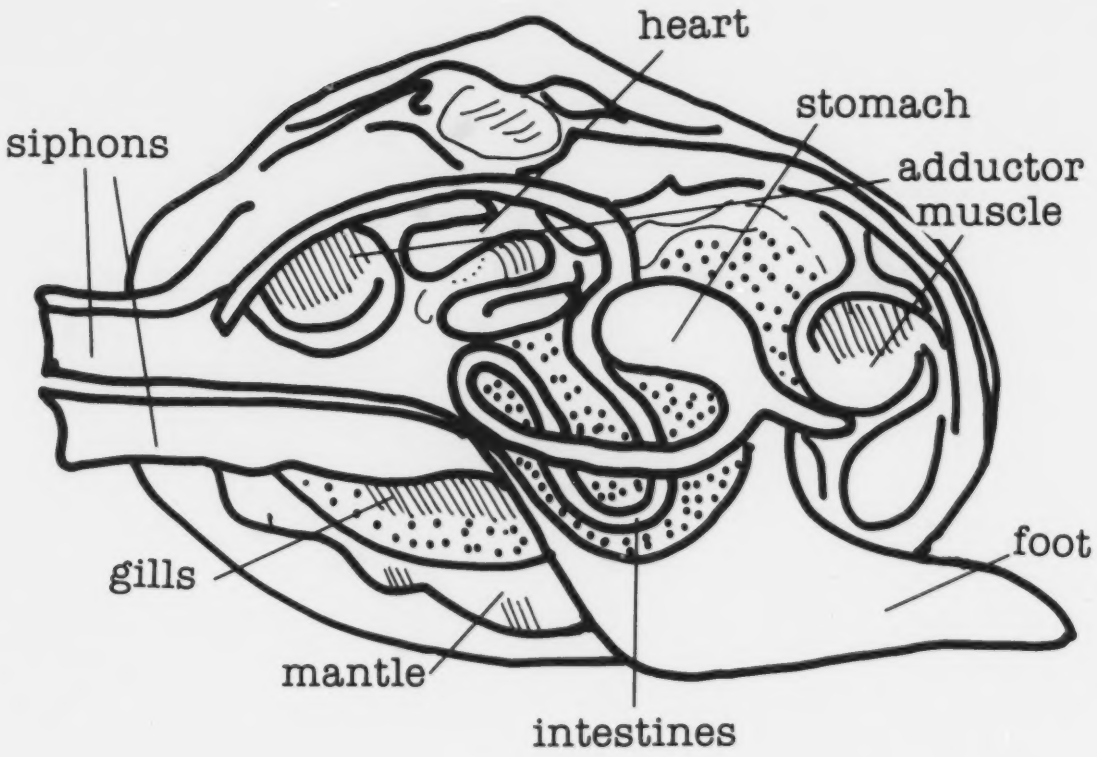
Bivalve shells



Color the hinge ligament white.
Color the muscle scars blue.
Color the hinge teeth yellow.
Color the rest of the shell brown.

Name _____

Bivalves have no head



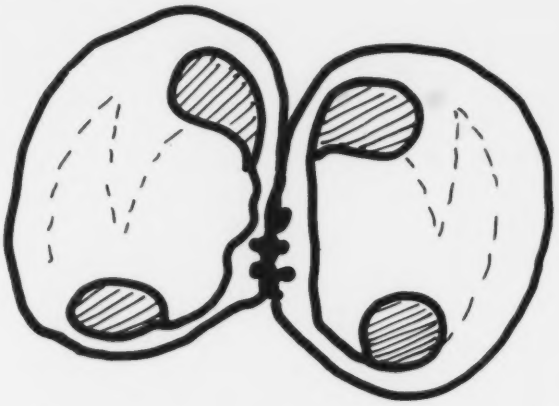
Color the stomach and intestines blue.
Color the heart red.
Color the siphons green.
Color the foot and mantle yellow.
Put a black X on the adductor muscles.
Color the gills orange.

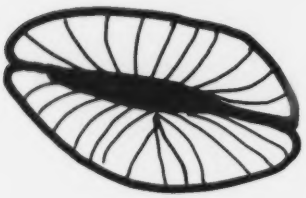
2-D
Name: _____

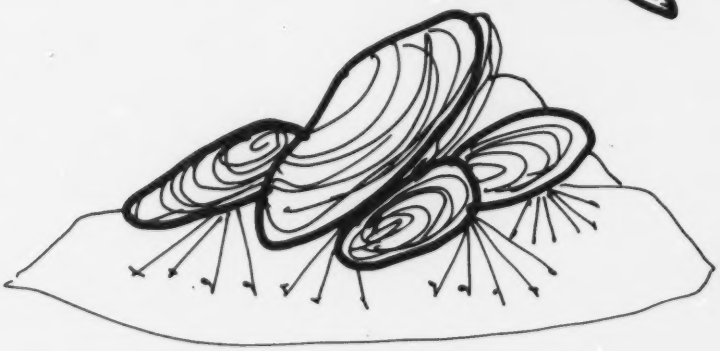
Bivalve Parts

Make a line from the word to its picture.

1. valve
2. hinge teeth
3. hinge ligament
4. adductor muscle
5. siphon
6. neck
7. foot
8. byssus







Name: _____

Clams

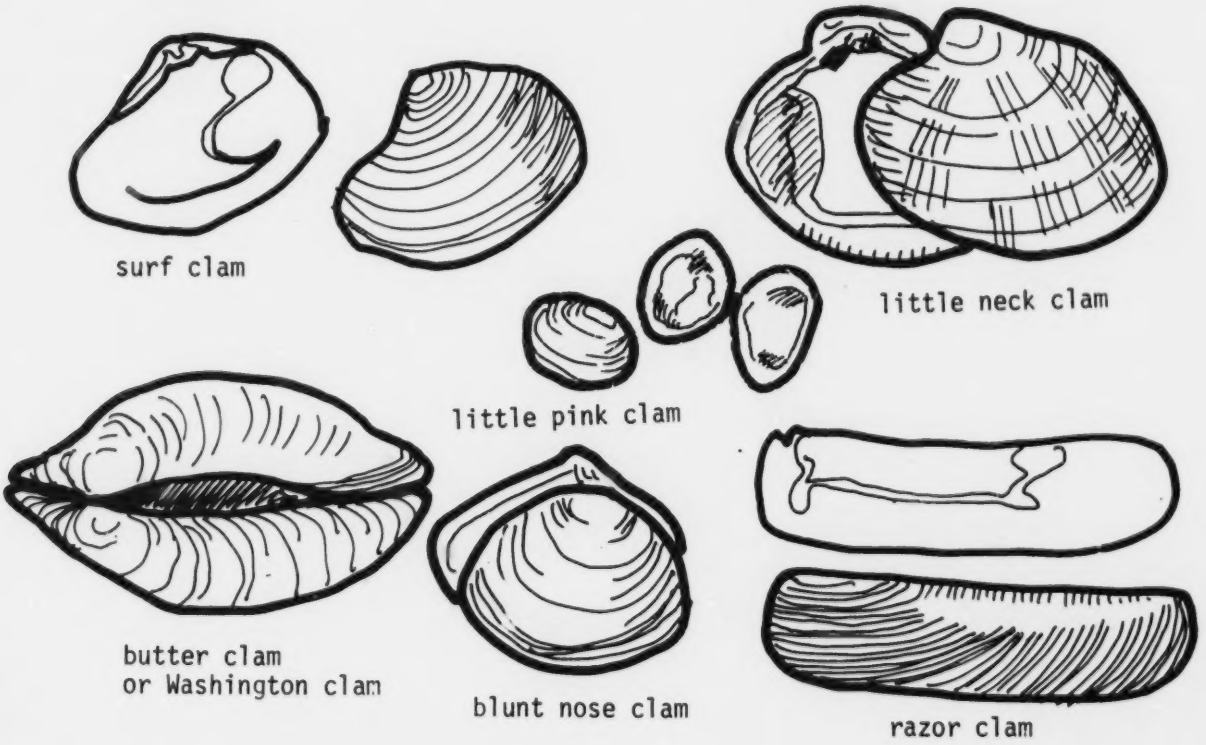
Clams live in the sand or mud. They can dig deep with a strong foot.

How do bivalves eat?

Bivalves use a long siphon that is like two straws to get their food. Tiny plants and animals that live in the water are a clam's food.

Water carrying these plants and animals is sucked into one part of the siphon.

Then the bivalves collect the plants and animals and push the water out the other part of the siphon.



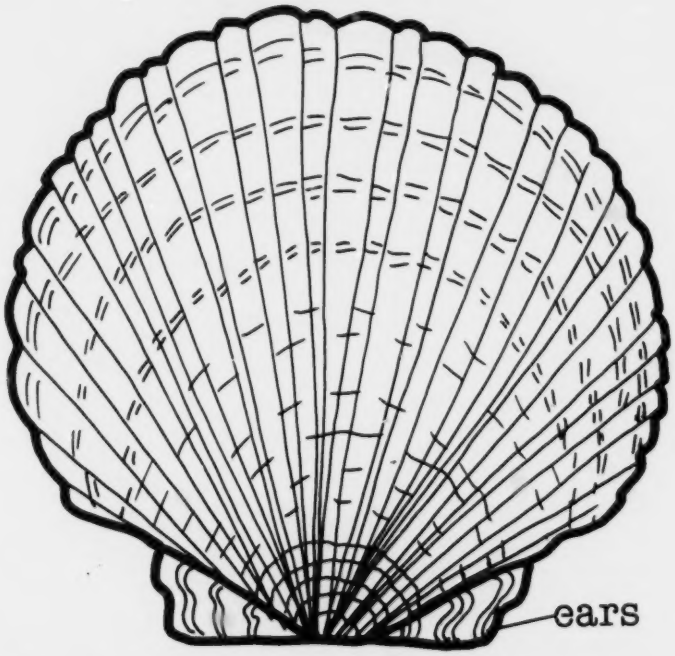
2-F

Name: _____

Scallops

A scallop swims by clapping its two valves together.

A scallop has wings or ears.

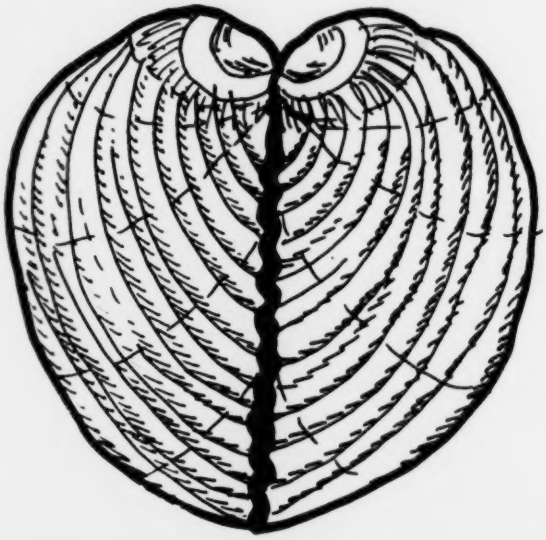


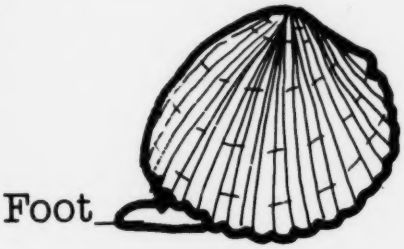
It has many tiny blue eyes and tentacles.

Name: _____

Cockles

Cockles are heart shaped when viewed from the side.
Cockles use their foot to dig into the sand.



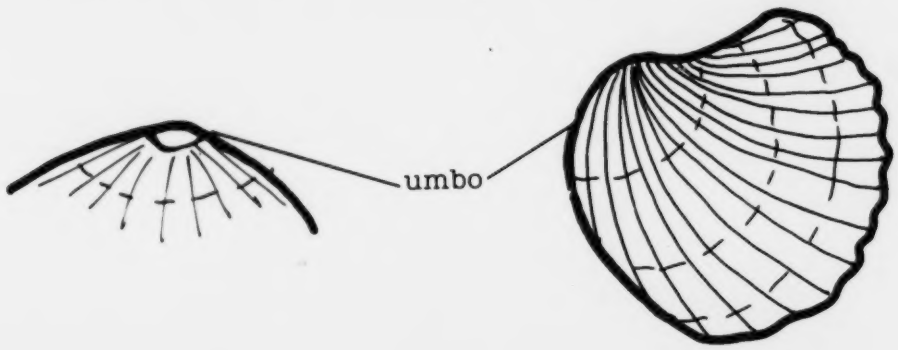


They can also use their foot to flip over and over to get away from sea stars.
Some sea stars like to eat cockles.

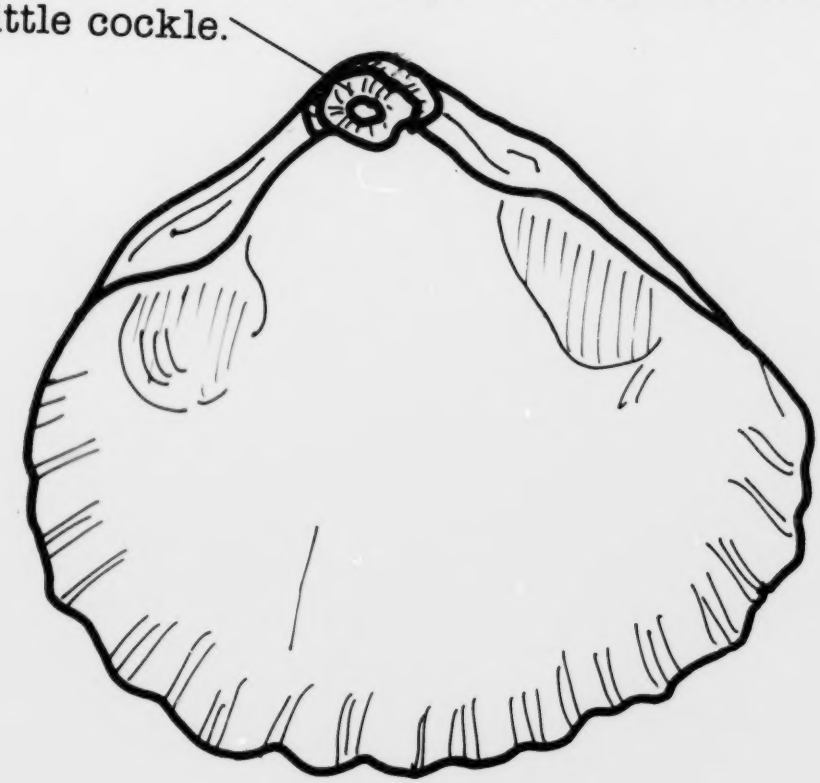
2-H
Name: _____

Umbo

The umbo is the oldest part of the shell.
Growth lines are very easy to see on a cockle.



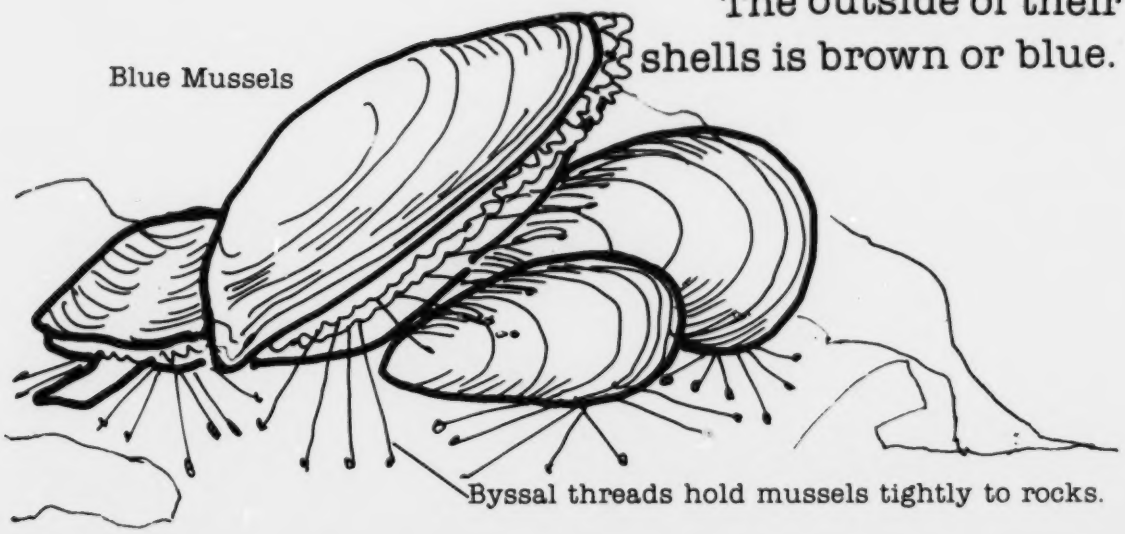
When you look at an umbo, you will see what looks like a little cockle.



Name: _____

Mussel Food

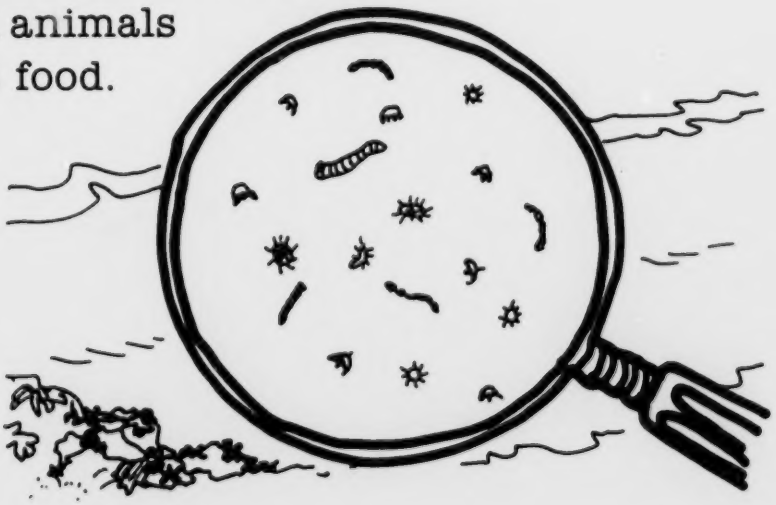
Blue mussels live on the beach.
They are bivalves.
The outside of their shells is brown or blue.



Blue Mussels

Byssal threads hold mussels tightly to rocks.

Mussels use their siphons to strain microscopic plants and animals from the water. These plants and animals are the mussel's food.



2-J

Name: _____

WHO AM I?

I dwell in a shell,
But I'm not a clam.
My name sounds like I'm strong.
Can you guess who I am?

Clues: I live on rocks.
I am a bivalve.
I am blue and black.
My name starts with "M".

I am a _____.

Draw me:

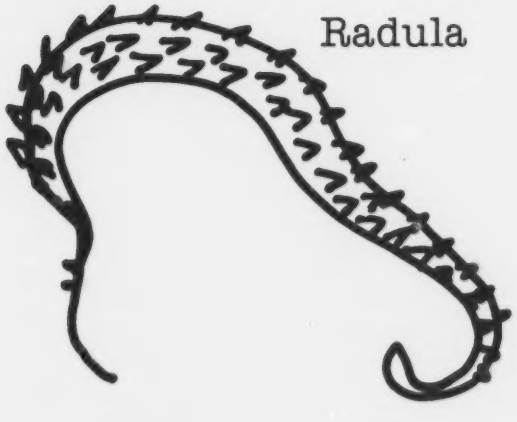
Name: _____

Univalve Vocabulary

A univalve is a mollusk. It has one shell.

Aperture This is the opening in the univalve shell.

Operculum This is the hard round plate that seals the shell opening of the univalve.



Radula This is a long ribbon that has many hooks. A univalve may use it to scrape tiny plants off rocks. Some univalves use the radula to drill holes into other animals' shells.

Spire This is the top of the univalve shell.

3-B
Name: _____

Whelk

(Nucella lamellosa)

This whelk is a snail with a long scientific name.

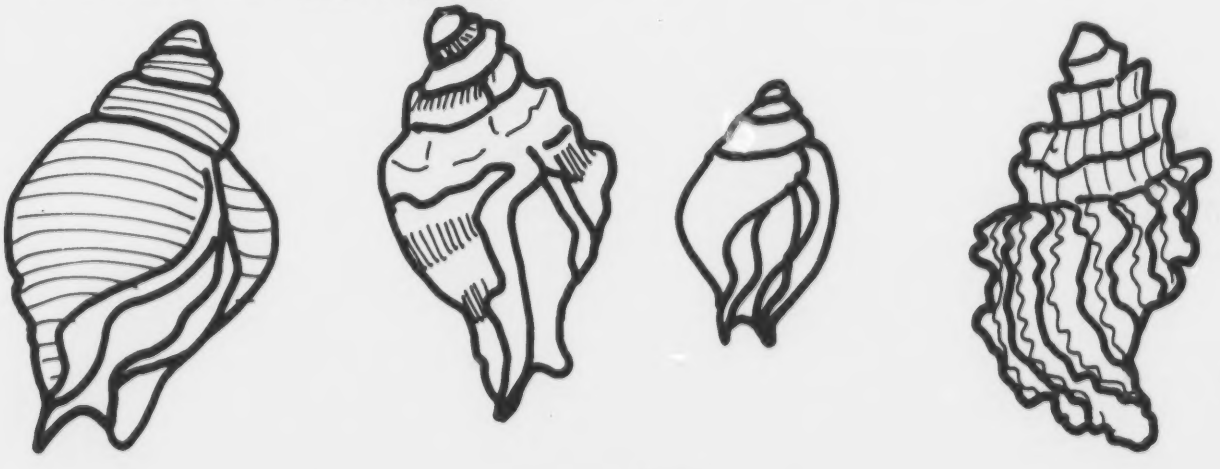
Nucella lamellosa.
(noo-cell-a lam-el-o-sa)
Can you say this name?

This snail lives on beaches in Alaska.

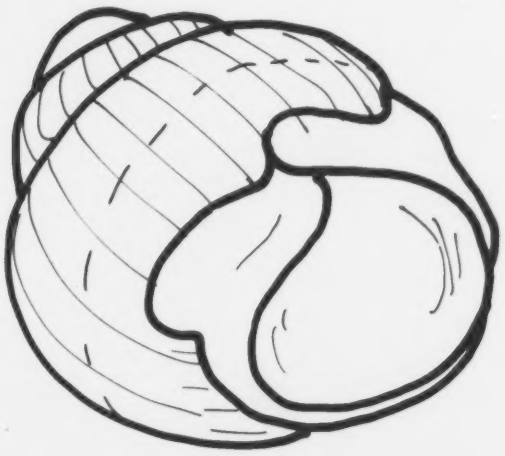
Each individual snail called Nucella lamellosa looks a little different from all others.

Some may be all one color. Some may have bands of white or purple or yellow.

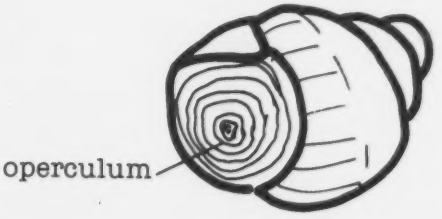
Color the Nucella lamellosa on this page to look like the ones on the beach.



Name: _____



Moon Snail
(Natica clausa)



A moon snail has a hard "door". This door is called an operculum.
The operculum is pulled into the shell opening to shut the moon snail in its shell.

A moon snail lays its eggs in a sand collar.
If you are lucky, you may find a sand collar on the beach.
Leave the sand collar on the beach. Then the eggs will hatch.

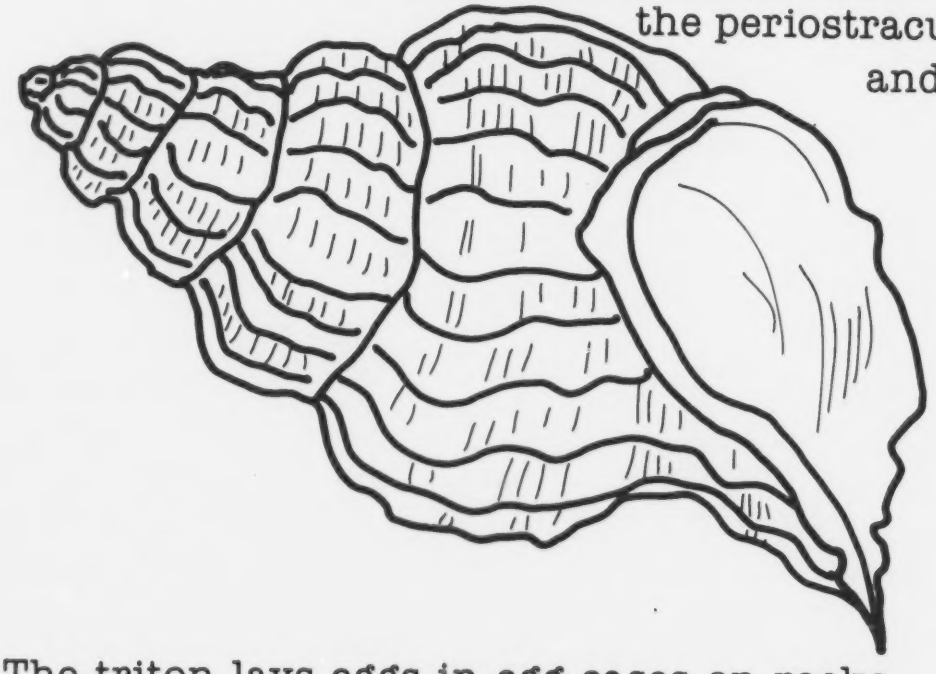
3-D

Name: _____

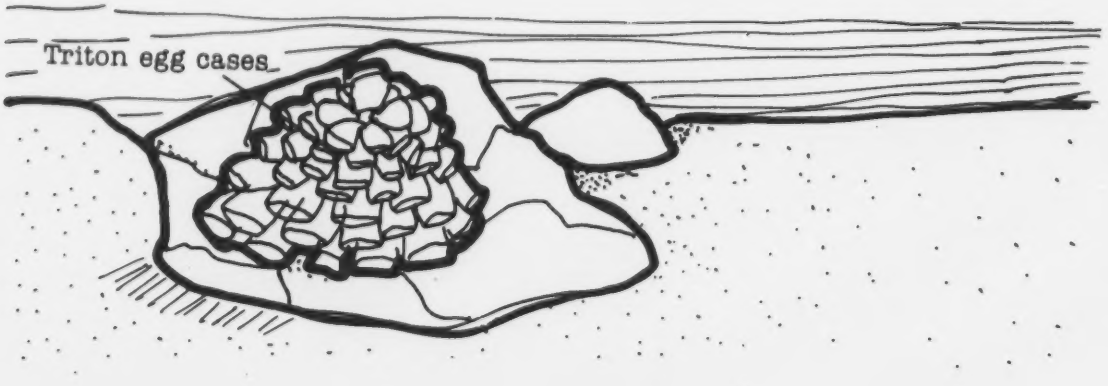
Hairy Triton

(Fusitron oregonensis)

The live hairy triton is covered with a layer of brown bristles called a periostracum. The shell under the periostracum is pink and very easy to break.



The triton lays eggs in egg cases on rocks. The cases are almost clear and are shaped like kernels of corn.



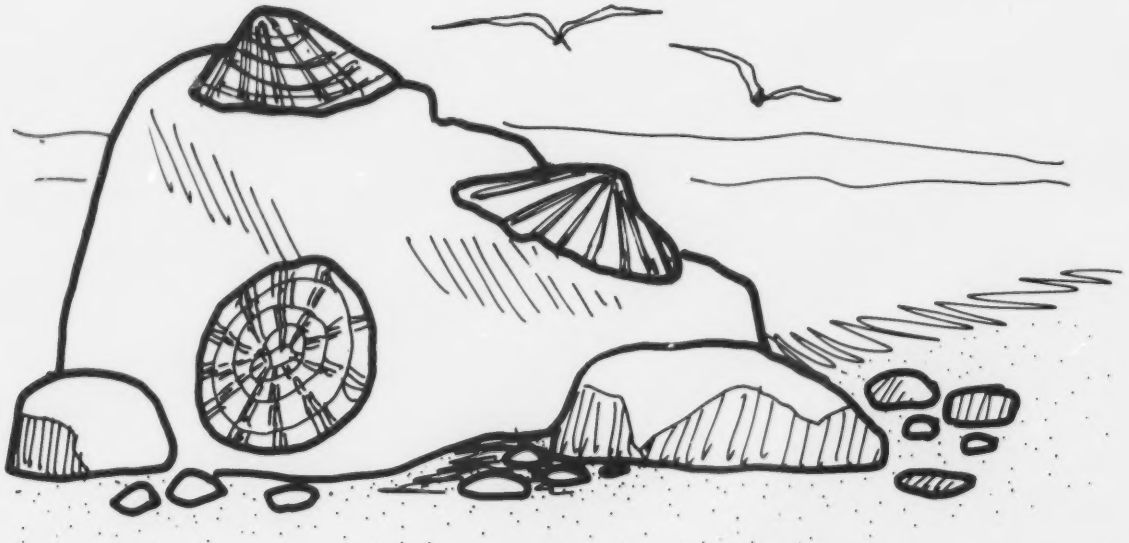
Name: _____

Limpet

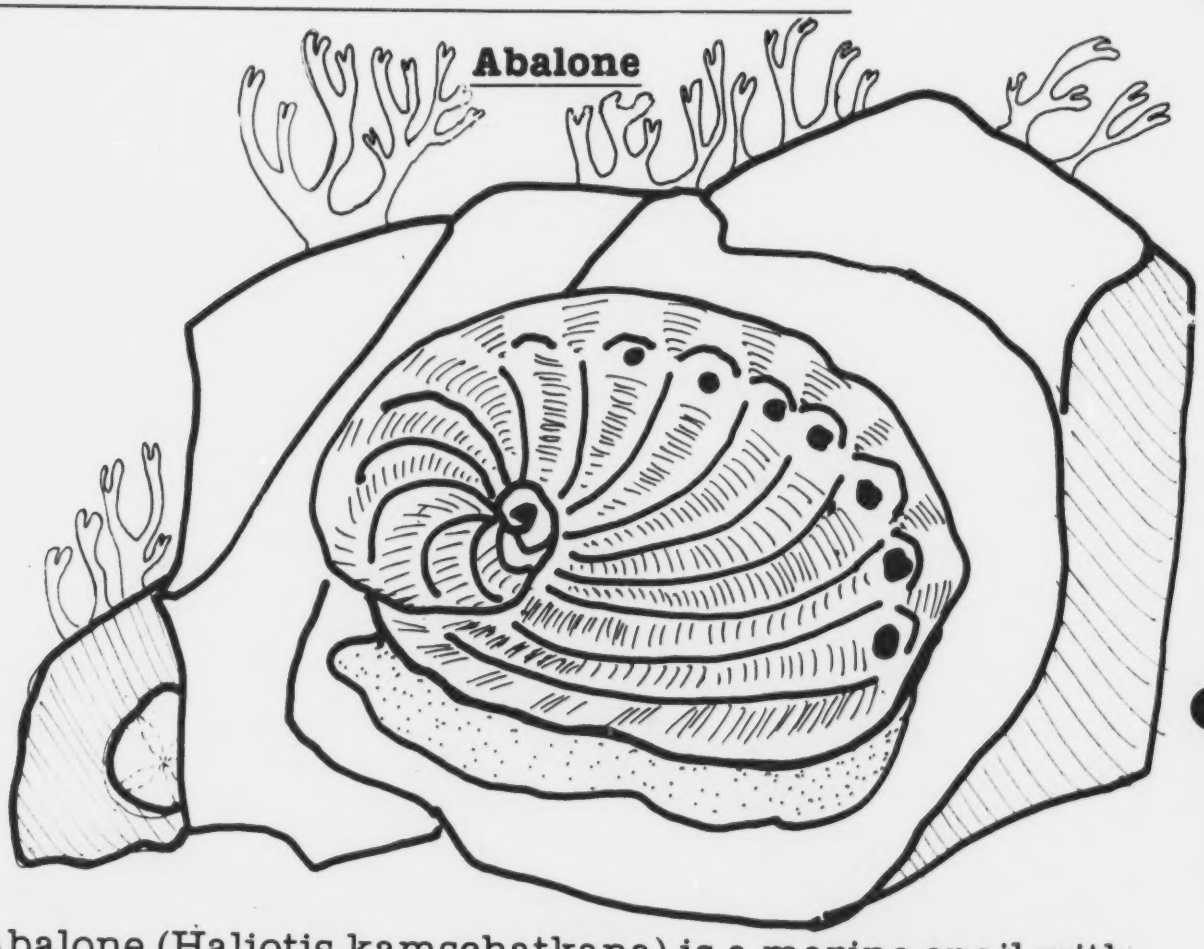
A limpet is a special kind of univalve.

Limpet shells look like pointed caps.

Limpets live on rocks or other hard objects. They eat algae or sea weed. They scrape the sea weed off rocks with their radula.



3-F
Name: _____



Abalone (Haliotis kamschatkana) is a marine snail with an oval shell that has 4 to 6 open holes. The inside of the shell is mother of pearl. With its foot the abalone can hold on tightly to the rocks over which it moves.

wooden dish with abalone decoration

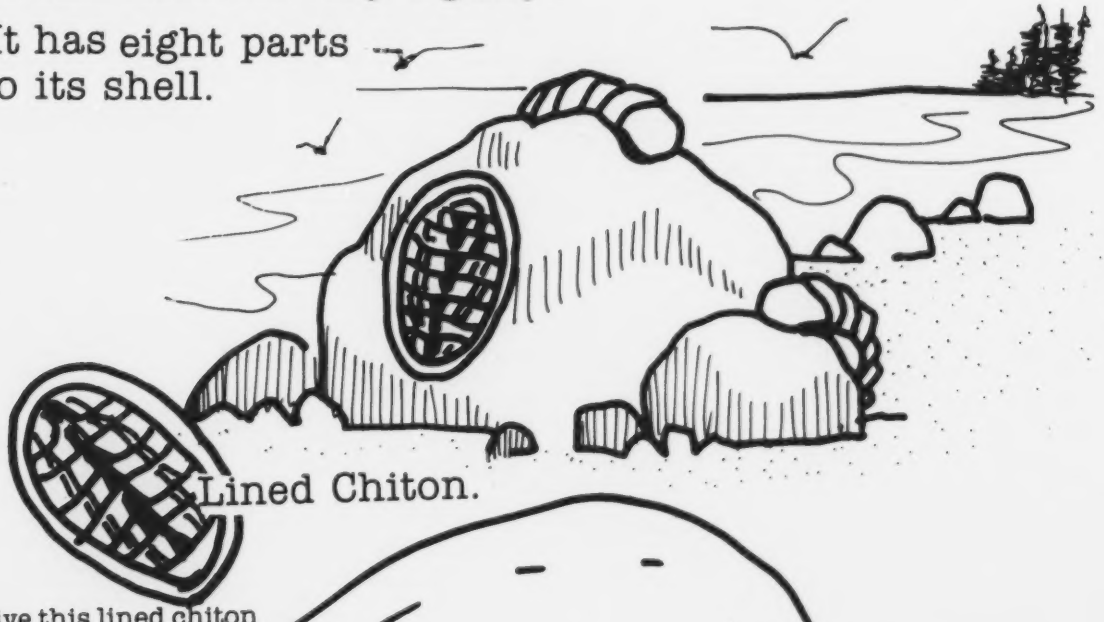
Abalone was used by Tlingit Indians for decoration and for trading as money.

Name: _____

Chiton

A chiton is a mollusk that can curve over a rock.
It can hold on very tightly.

It has eight parts
to its shell.



Lined Chiton.

give this lined chiton
spots and stripes
of many colors.

Giant Pacific Chiton

color the giant chiton dark red.

One of the largest chitons in Alaska, it has been used for a long time as food by the southeast Alaska Indians.

Katy Chiton

Color the Katy Chiton
black with white valves.
This chiton is used for food too.

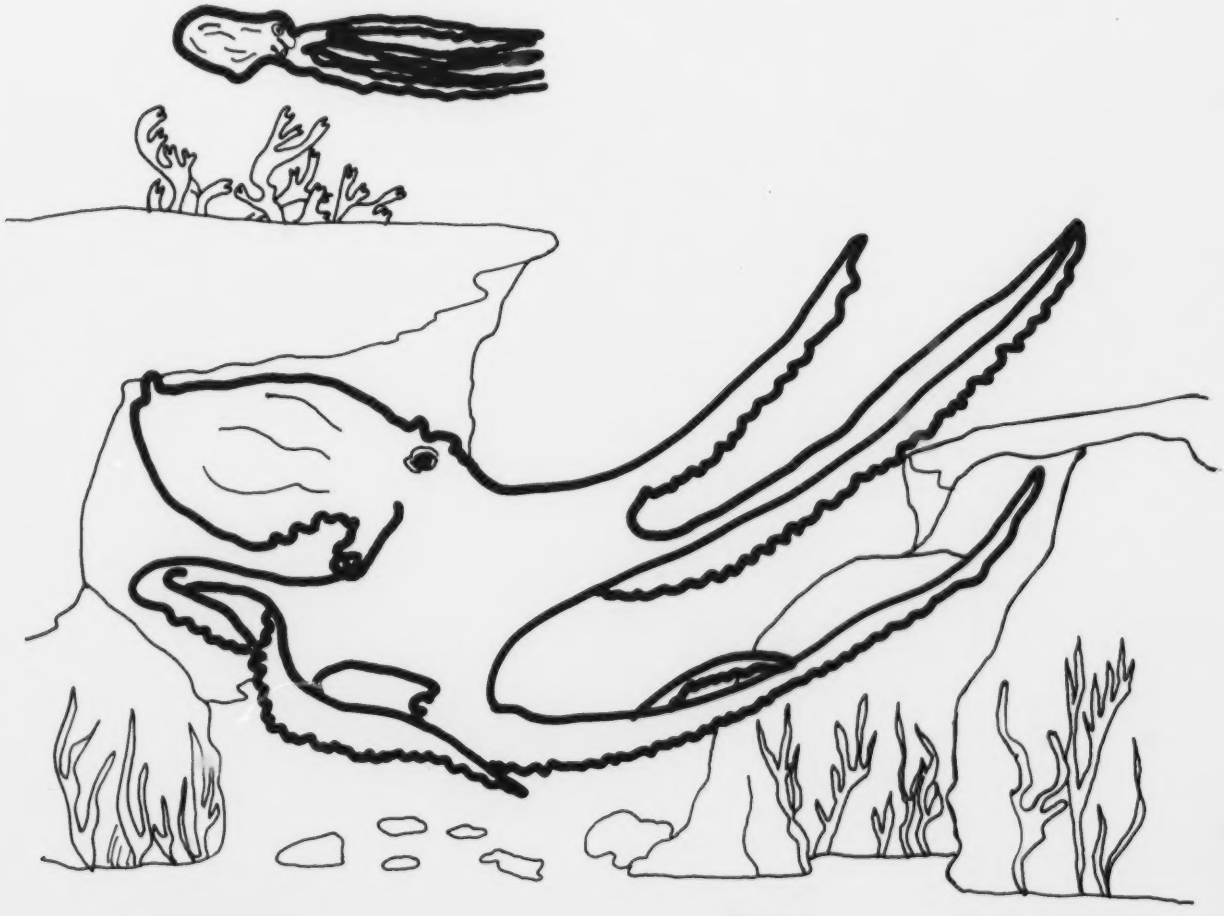
5-A

Name: _____

Octopus

An octopus swims by "jet propulsion". It can squirt black ink to confuse an enemy and change color in an instant.

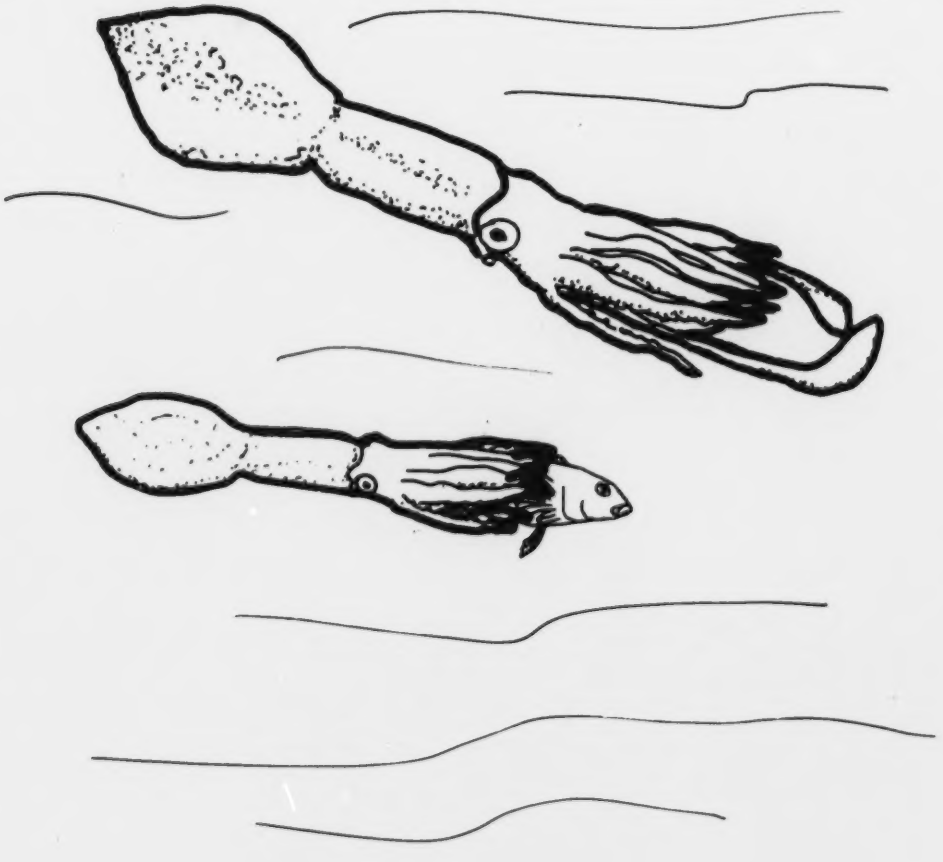
The octopus lives in holes or cracks.
It is an intelligent animal.
Color these octopi to match their locations.



Name: _____

Squid

A squid has eight arms and two "tentacles". It eats small fish and shrimps. A squid can change its color and can swim by "jet propulsion".



5-C

Name: _____ .

The Hungry Octopus

When you hear the tap, tap, tap, of their beak-ie,
When you see those eight long arms charg-in for you,
don't let them drill a hole in your shell.
you'd bet-ter hide and roll with the tide.
They love to crunch and munch on you for lunch,
Cause when you see those eight arms chargin for you,
so don't let them drill a hole in your shell.
It will be crunch, munch, you'll be served for lunch.

Ounce of Prevention Game

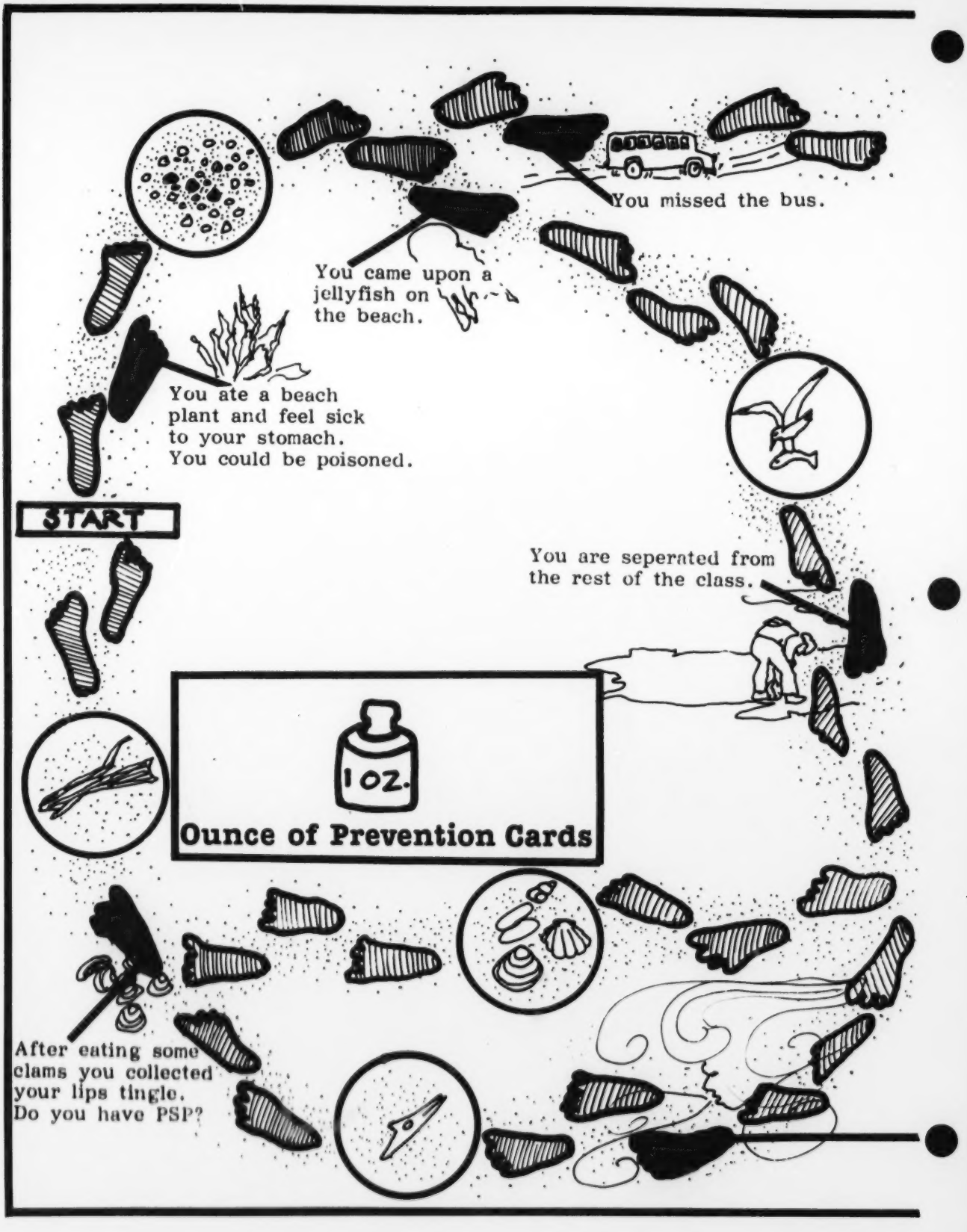
Directions

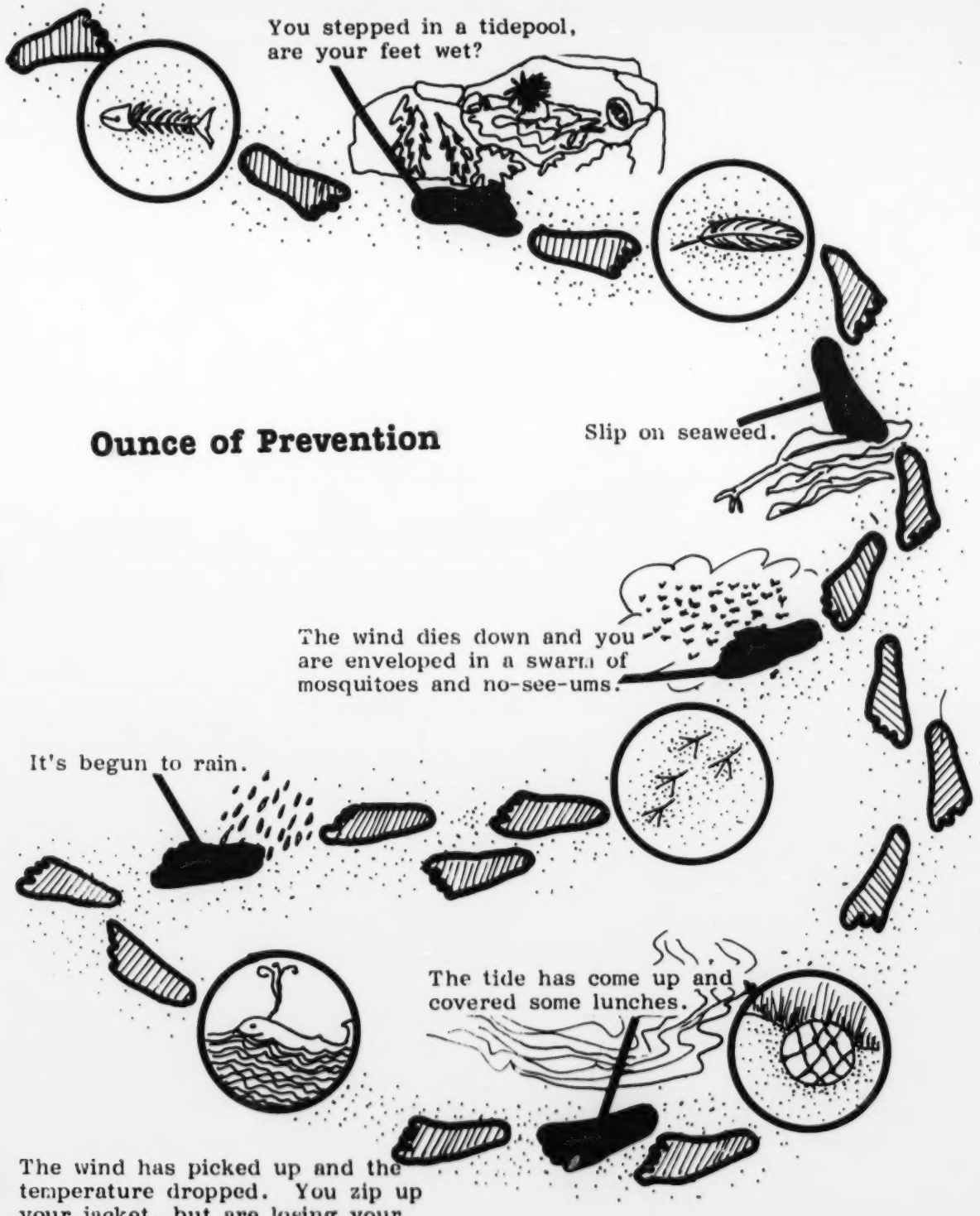
1. Move markers along trails according to the number of footprints on one die.
2. Shuffle cards before the game begins, and place them on the 1-Ounce box.
3. Game continues along choice of trails, collecting special treasures and escaping from hazards.
4. Special treasures are in circles on trails. Player collects them by landing on circle.
5. Escape from hazards by drawing one card per turn until the needed card is drawn.
6. Game ends when one player collects all 10 treasures.
7. No two markers can occupythe same treasure at one time. However, as many as are trapped can remain in one hazard.
8. Mark Treasure Tally cards with washable pen or crayon as each is "collected."

Game Preparation

1. To prepare this game, tape two sheets of the game board together and laminate or cover with contact paper.
2. Make six copies of the cards. Glue to cardboard, then laminate or cover with contact paper. Cut out the "Ounce of Prevention" cards.
3. Use pebbles, driftwood, fish vertebrae, sand-frosted beach glass for game markers.
4. Copy enough Treasure Tally cards for each player. Laminate or cover with contact paper.
5. Use one die for the game.

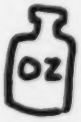
6-A


You missed the bus.
You came upon a jellyfish on the beach.
You ate a beach plant and feel sick to your stomach. You could be poisoned.
START
You are seperated from the rest of the class.
1 OZ.
Ounce of Prevention Cards
After eating some clams you collected your lips tingle. Do you have PSP?


You stepped in a tidepool, are your feet wet?
Slip on seaweed.
The wind dies down and you are enveloped in a swarm of mosquitoes and no-see-ums.
It's begun to rain.
The tide has come up and covered some lunches.
The wind has picked up and the temperature dropped. You zip up your jacket, but are losing your body heat through your head.

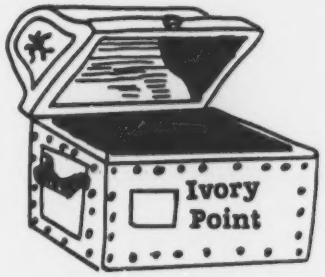
Ounce of Prevention

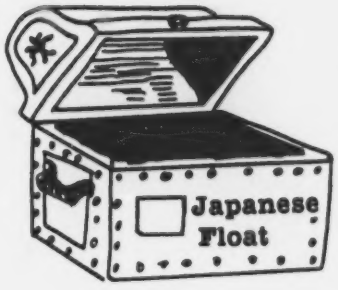
6-A

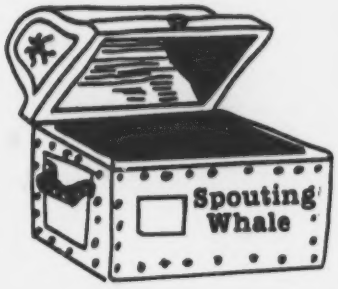
You remembered to wear your PFD.	You remembered to bring your raincoat.
You collected clams on a beach OK for PSP.	You are wearing insect repellent.
You positively identified the plant before you ate it.	You are with your "buddy" and did not wander off by yourself.
You were attentive to your teachers return signal.	You remembered to put all your belongings above the high tide line.
You wore a wool hat or scarf.	You have on your rubber boots. 
You didn't step on living animals.	**Ounce of Prevention Cards**

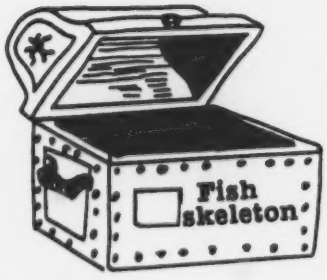
Name: _____

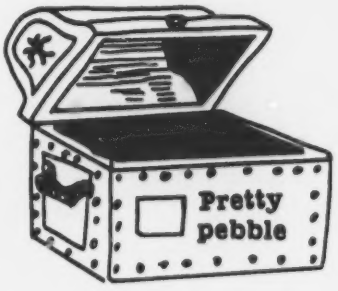
Treasure Tally Cards

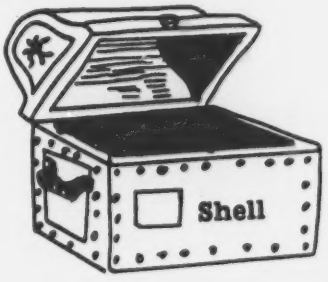


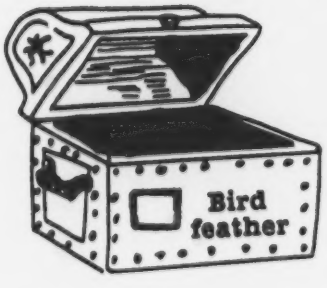


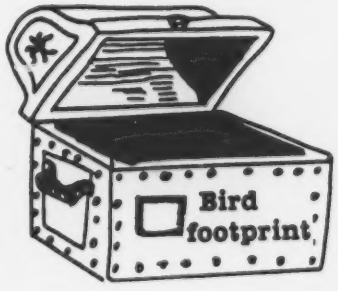


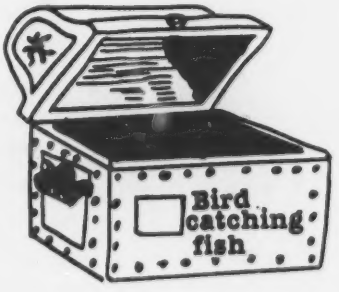












6-B

barnacles

how many? ☐

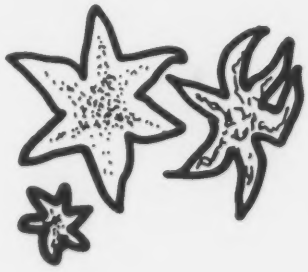
FOLD LINE

Name: _____

Beach Book

CUT LINE

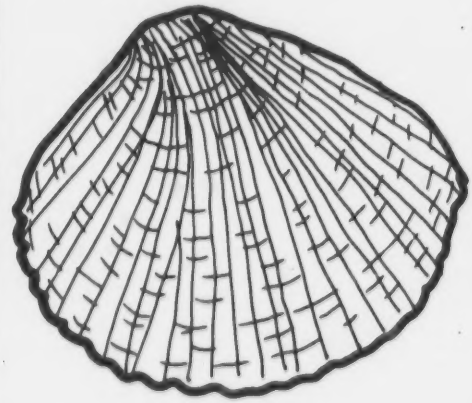
six-rayed sea star



how many? ☐

FOLD LINE

cockle

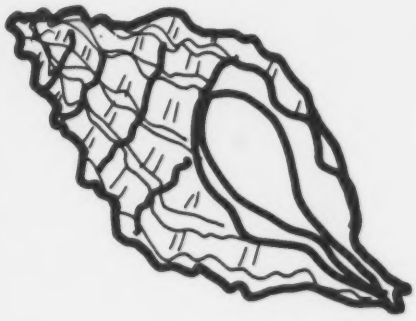


how many? ☐

octopus

how many? □

whelk



how many? □

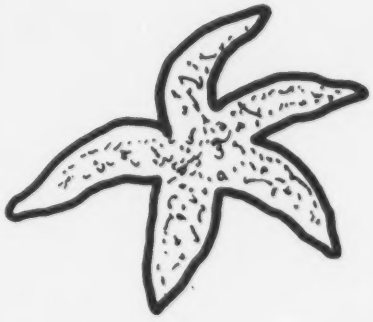
FOLD LINE

CUT LINE

brittle star

how many? □

sea star



how many? □

FOLD LINE

6-B

jellyfish

how many? ☐

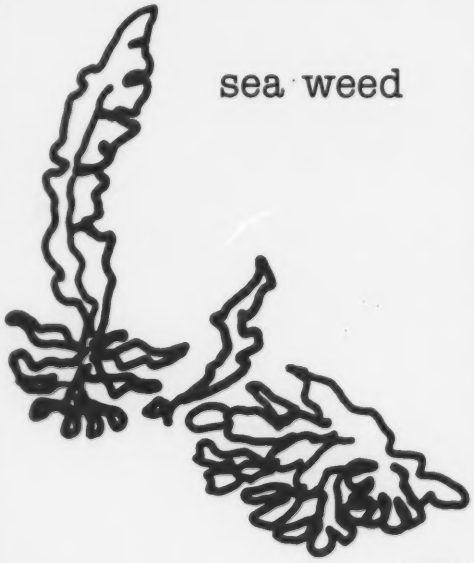
sponge

how many? ☐

FOLD LINE

CUT LINE

sea weed



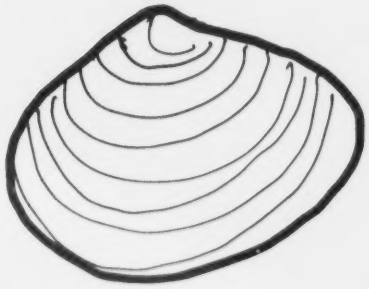
how many? ☐

sea anemone

how many? ☐

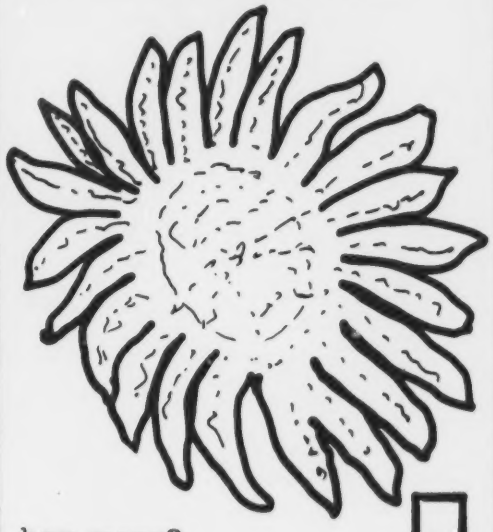
FOLD LINE

clam shell



how many? ☐

sunflower sea star

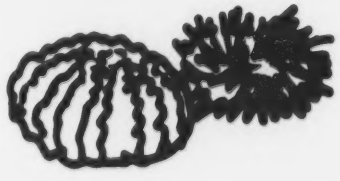


how many? ☐

FOLD LINE

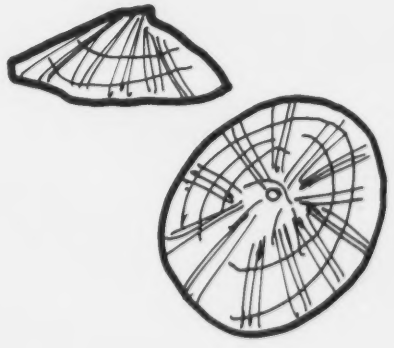
CUT LINE

sea urchin



how many? ☐

limpet

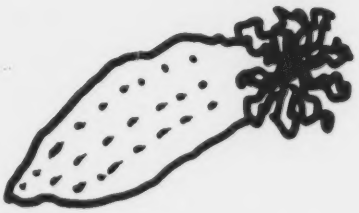


how many? ☐

FOLD LINE

6-B

sea cucumber



how many? ☐

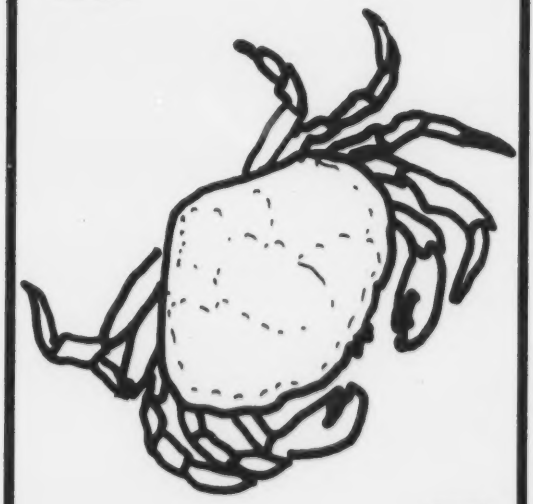
chiton

how many? ☐

FOLD LINE

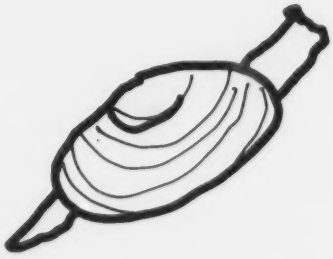
CUT LINE

crab



how many? ☐

live clam



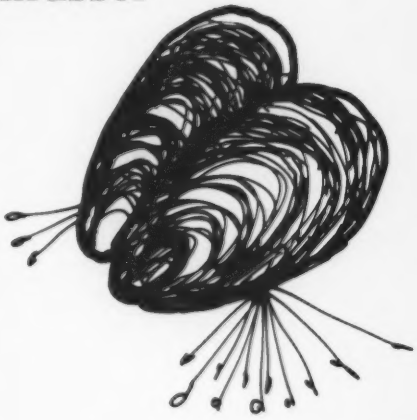
how many? ☐

FOLD LINE

squid

how many? ☐

mussel



how many? ☐

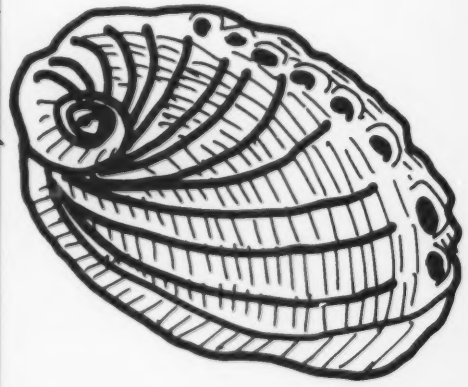
FOLD LINE

CUT LINE

rock oyster (jingle)

how many? ☐

abalone



how many? ☐

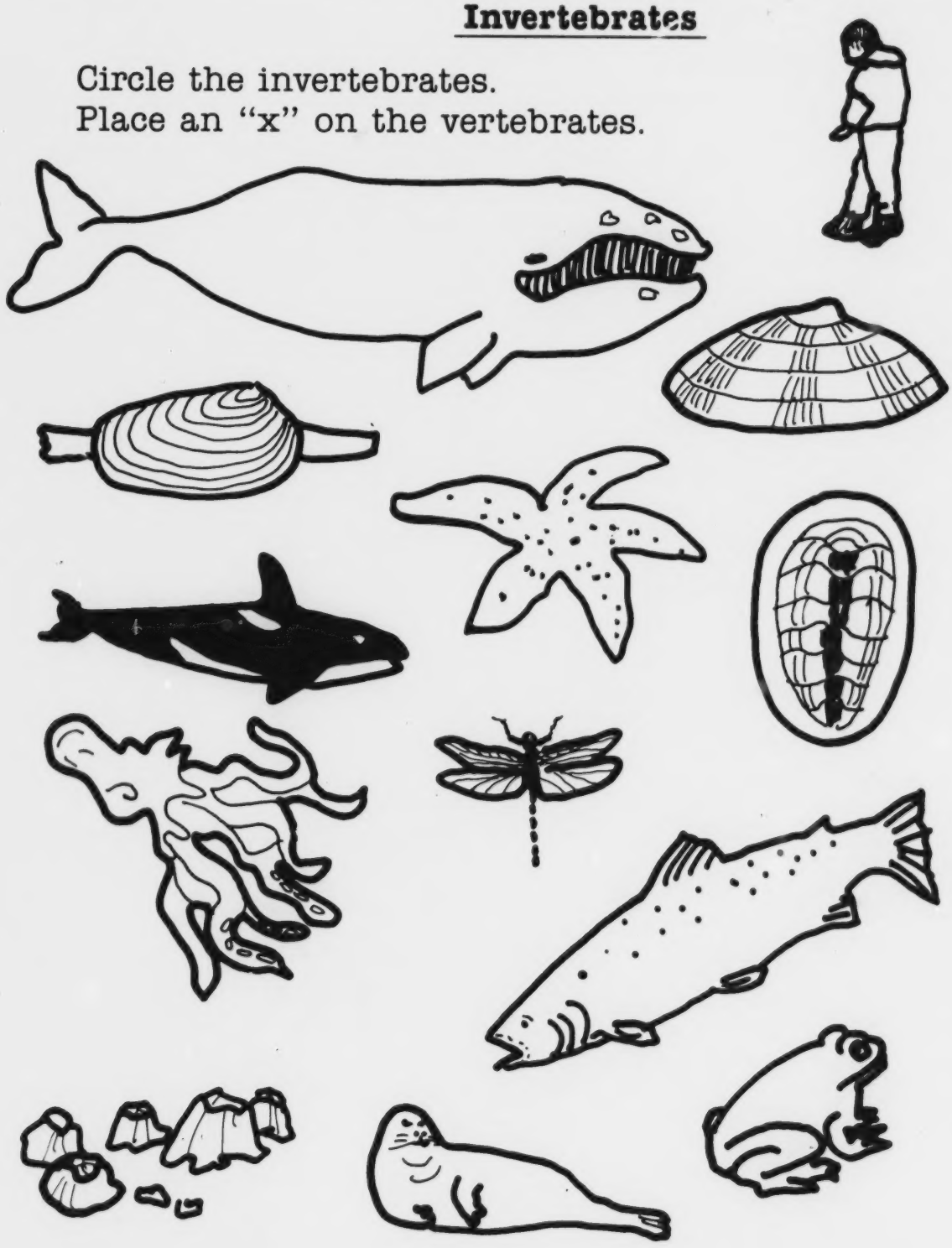
FOLD LINE

7-A

Name: _____

Invertebrates

Circle the invertebrates.
Place an "x" on the vertebrates.



Name: _____

Similarities and Differences

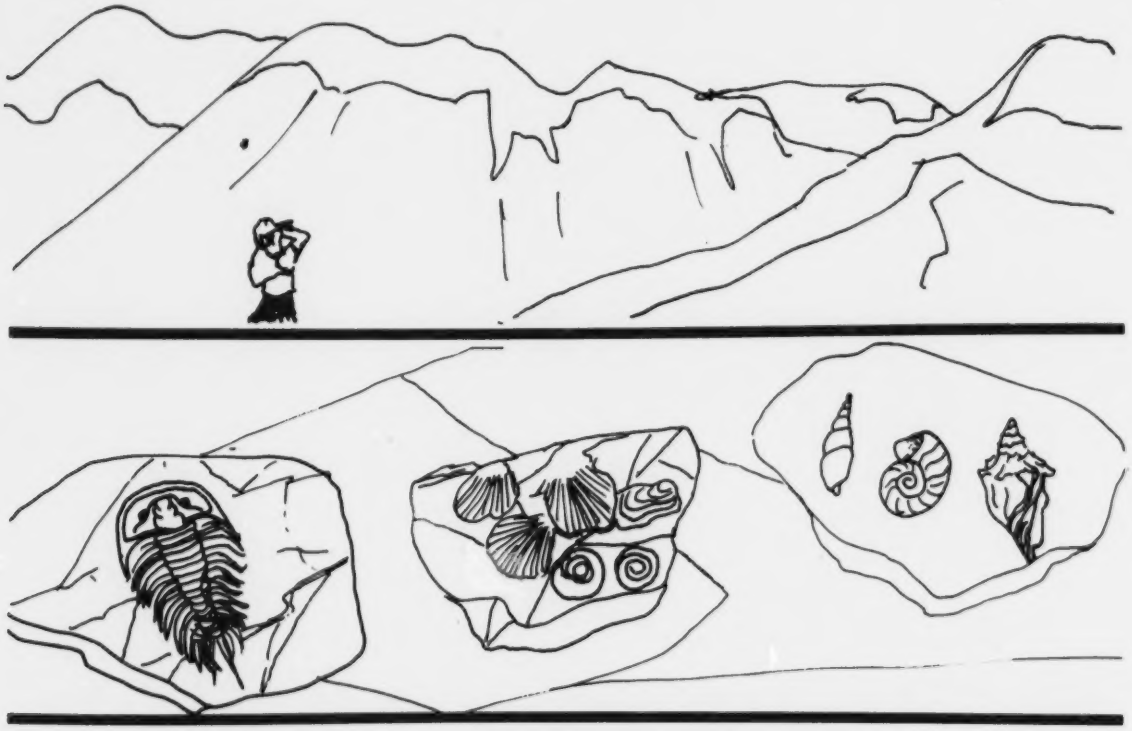
Vertebrate	Invertebrate

List similarities and differences.

Similarities	Differences
1.	1.
2.	2.
3.	3.

7-C

Name: _____



Fossils

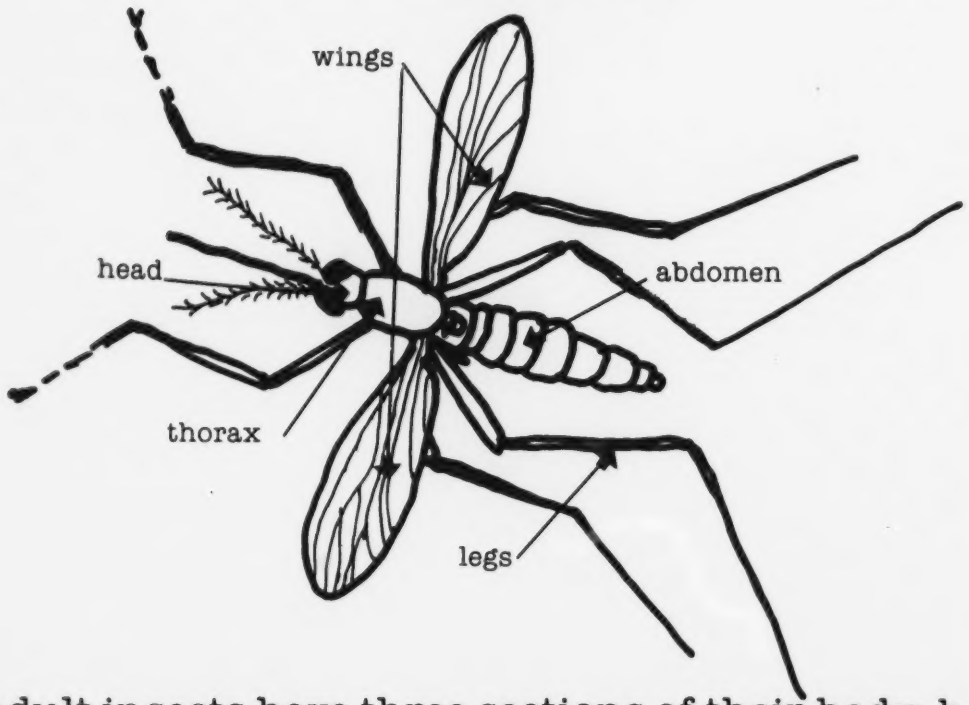
Do these shells live on top of a mountain today?

Yes No

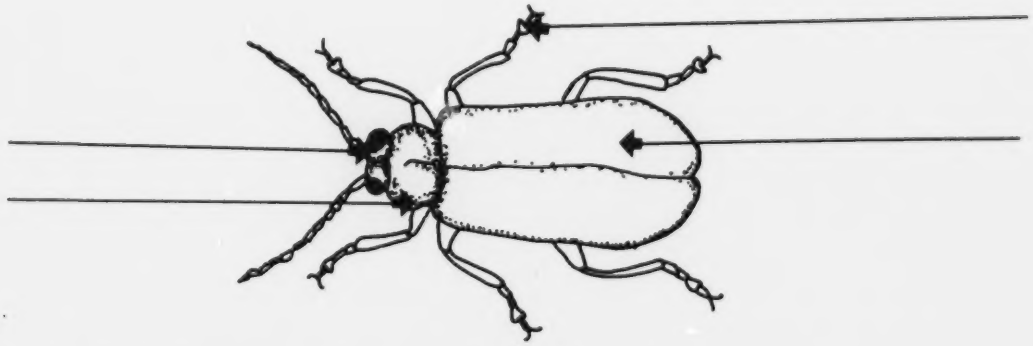
Draw a picture in this space of a shell where it lives today.

Name: _____

Insect Parts



Adult insects have three sections of their body, h_____, th_____, and ab_____. Attached to the thorax are two or four w_____ and six legs.

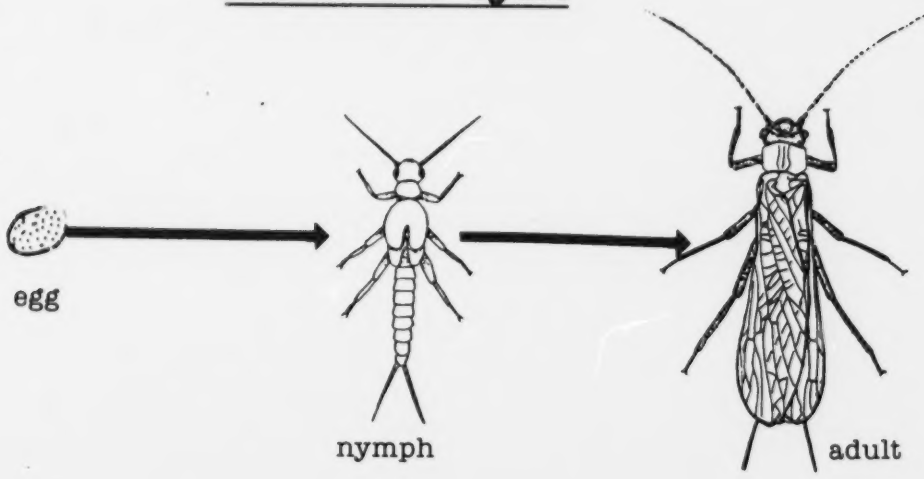


Fill in the blanks with name of insect body parts.

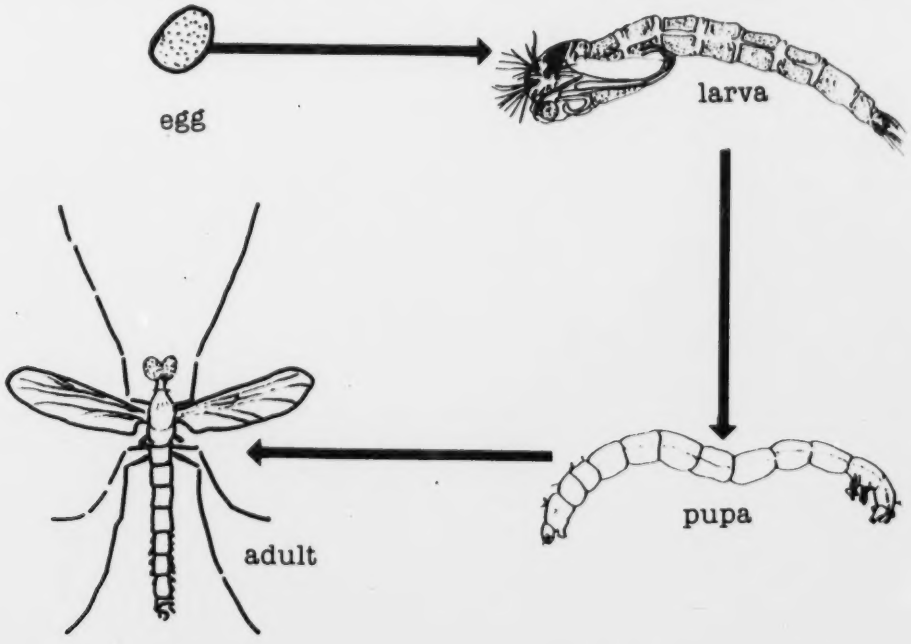
8-B

Name: _____

Insect Life Cycle



Gradual metamorphosis of a stonefly.

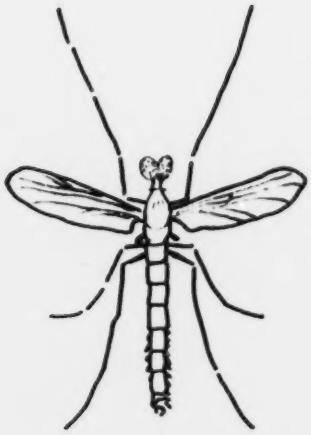


Complete metamorphosis of a midge.

Name: _____

Midge

Fill in adult, larva, pupa



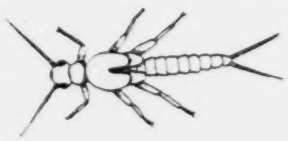
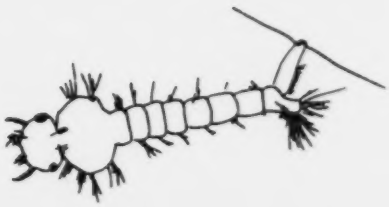
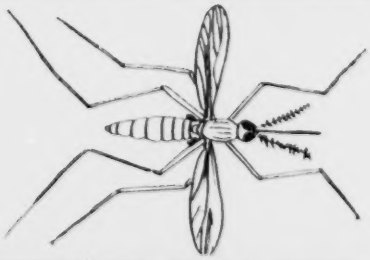
_____ _____ _____

Adult midges have_____wings, just like all true flies.
number

The midge larva can be found on the_____
location
ponds and streams.

8-D

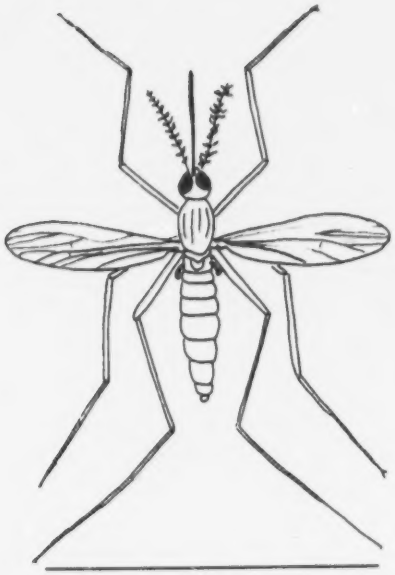
Name:

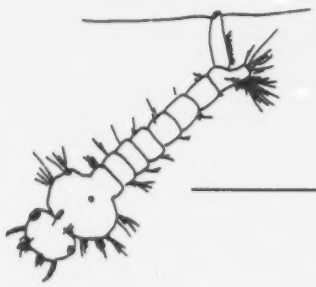
Metamorphosis Squares Cut and rearrange to show life cycle of stonefly and mosquito.	Complete Metamorphosis
	
Gradual Metamorphosis	
	

Name: _____

Mosquito

Fill in female, larva, adult, pupa male, tail.





_____

_____

Mosquito larvae breathe through a tube near their_____

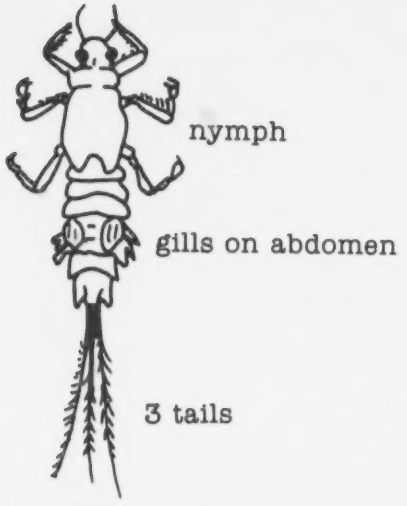
Adult_____ mosquitoes suck blood.

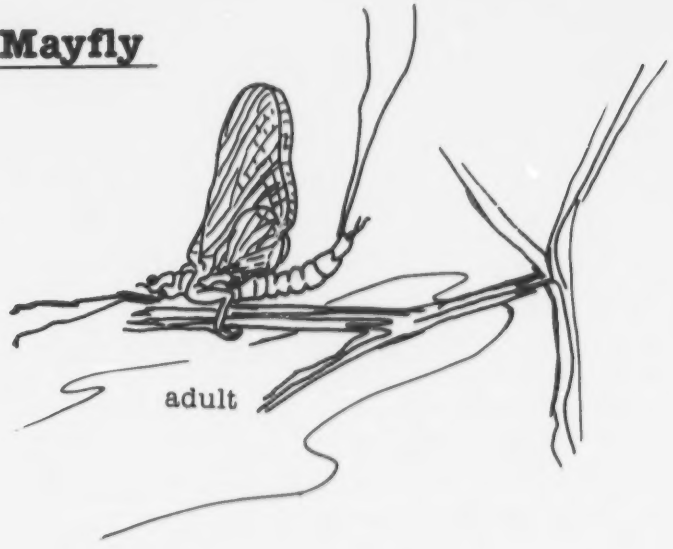
The adult_____ mosquitoes suck plant jucies.

8-F

Name: _____

Mayfly





Mayflies often live only one_____
Usually a large swarm of adults emerge from the water at once.

After laying eggs, they die on the surface.

Both adults and nymphs are important food for other insects and fish. Mayflies eat plants.

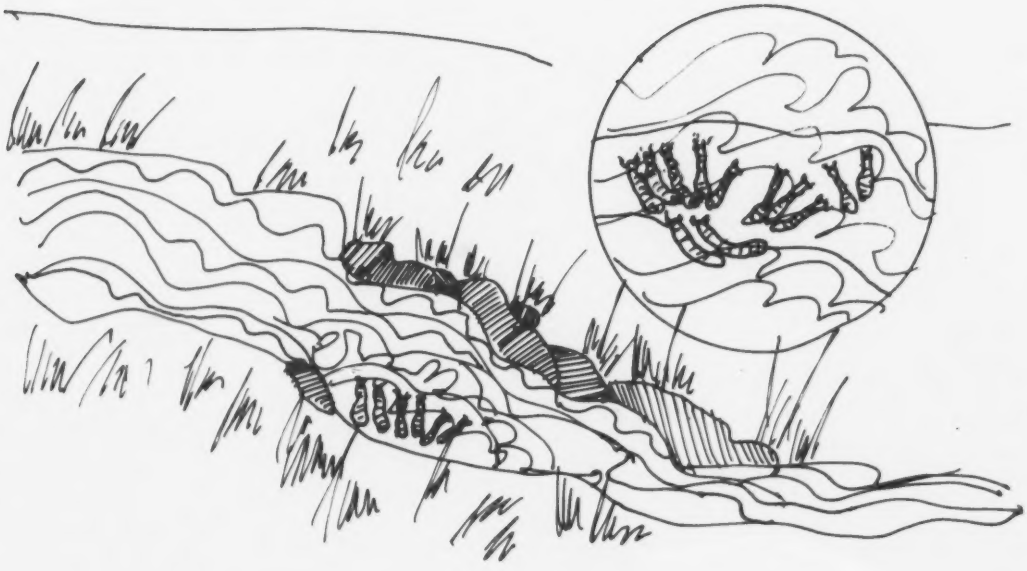
Name: _____

Black Fly

adult

larva

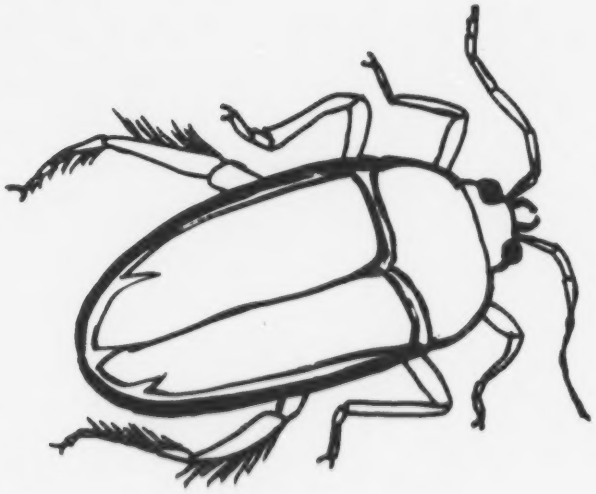
pupa



8-H

Name: _____

Predacious Diving Beetle



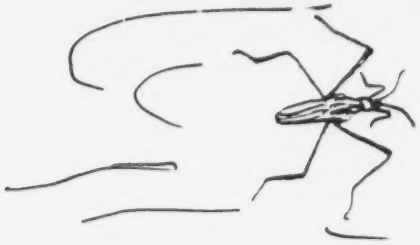
color the beetle
dark brown or black

Predacious diving beetles chase and eat tadpoles, insects and even small fish.

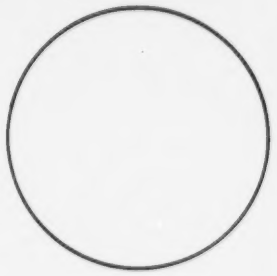
Beetles are eaten by frogs, fish and birds.

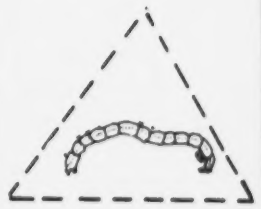
Name: _____

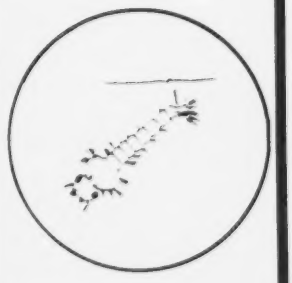
Insect Predators.

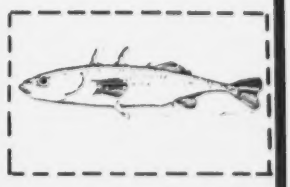


Match predator and prey.







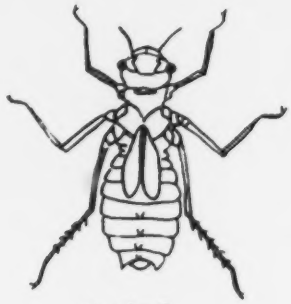


8-J

Name: _____

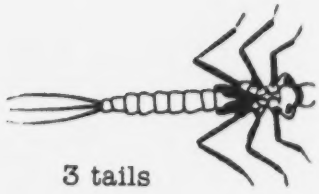
Fill in the blanks with adult, nymph, and mosquito.

Dragonfly



no tail

_____ _____



3 tails

Damsel Fly

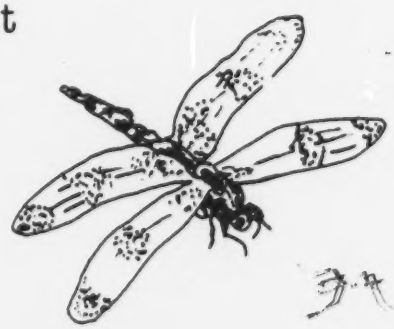
_____ _____

dragonfly nymph

with lower mouth opening to catch prey.

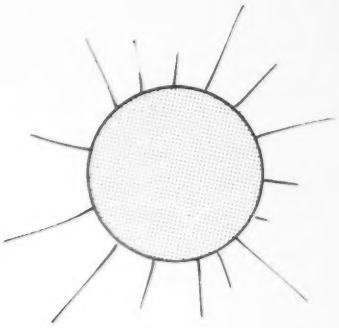
Dragon flies and Damsel flies eat

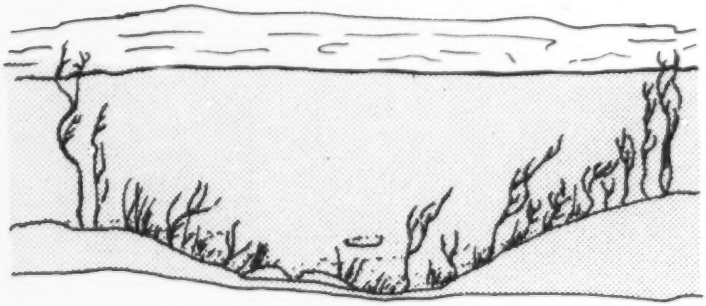
_____

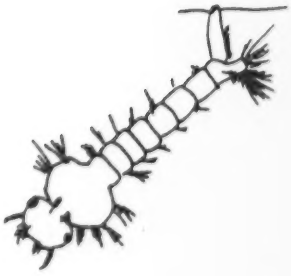


Name: _____

Dragon Fly Home







8-L

Name: _____

Insects at Home

Fill in the blanks with these words:
plant
habitat
bottom
dragonfly
open water
surface

The pond is the insects_____

In this picture the damselfly nymph is on the_____

The water strider is on the water_____

The diving beetle is in the_____

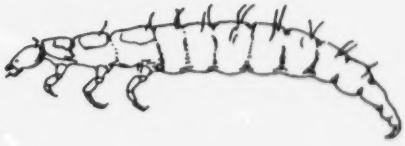
The adult_____lives out of the water.

The dragonfly nymph is on the_____

Name: _____

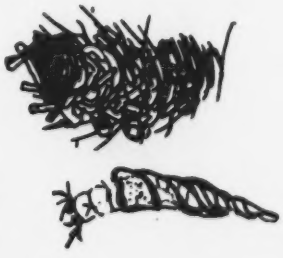
Caddis Fly

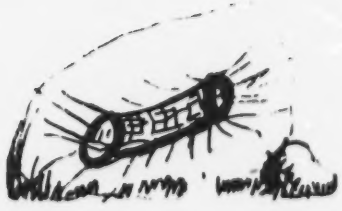
Caddis fly larvae scrape food off rocks,
eat dead leaves and collect plankton for food.



_____ _____

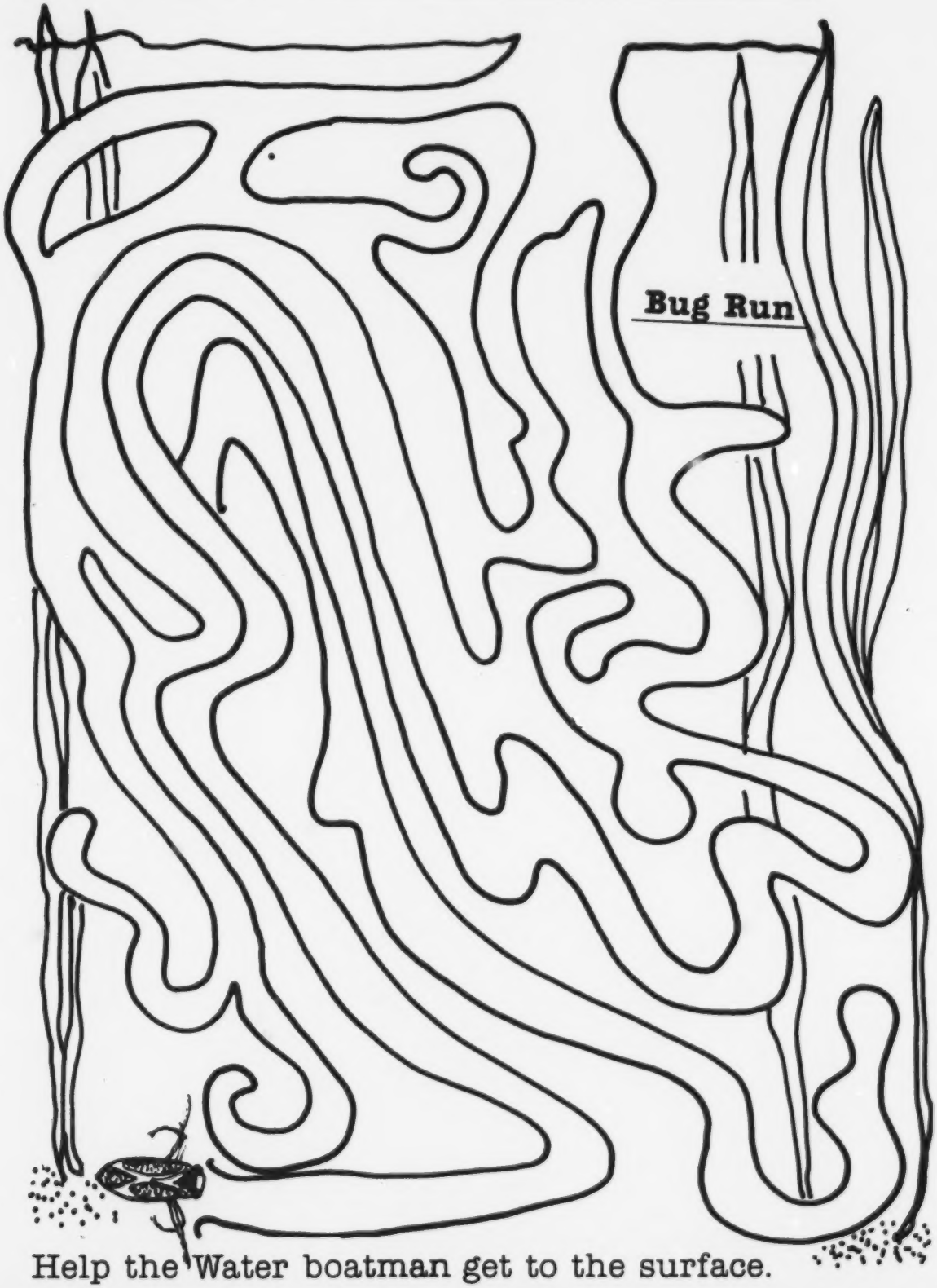
Label cases, adult, larva.





_____

8-N Name: _____



Help the Water boatman get to the surface.

Water boatman

How many seen?
Few
Some
Many

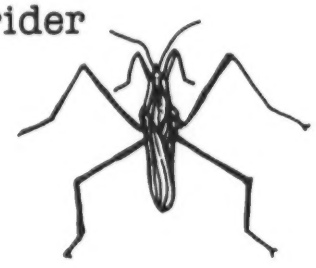
Where seen?

FOLD LINE

Name:

Field Trip Book

Water strider



How many seen?
Few
Some
Many

Where seen?

CUT LINE

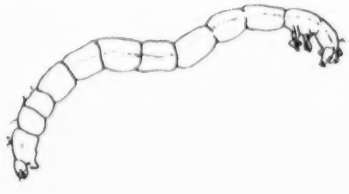
Caddis fly larva

How many seen?
Few
Some
Many

Where seen?

FOLD LINE

Midge larva



How many seen?
Few
Some
Many

Where seen?

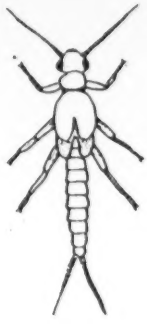
9-A

Mayfly nymph

How many seen?
Few
Some
Many

Where seen?

Stonefly nymph



How many seen?
Few
Some
Many

Where seen?

FOLD LINE

CUT LINE

Predacious diving beetle

How many seen?
Few
Some
Many

Where seen?

Mosquito larva

How many seen?
Few
Some
Many

Where seen?

FOLD LINE

Dragonfly

How many seen?
Few
Some
Many

Where seen?

FOLD LINE

Dragonfly nymph

How many seen?
Few
Some
Many

Where seen?

CUT LINE

Damselfly nymph

How many seen?
Few
Some
Many

Where seen?

FOLD LINE

Damselfly

How many seen?
Few
Some
Many

Where seen?

10-A Page 1

Name: _____

Organisms in their Habitat

Place organisms from page 2 in their habitat.

Name: _____

Organisms in their Habitat

Color these organisms and place in their habitat on page 1.

10-B

Name: _____

Insect Word Search

Reading forward, backward, up, down or diagonally, (but always in a straight line and not skipping any letters), you can find the names of 41 insects in the diagram below. To help, the names are given below. Circle the name of the insect in the puzzle when found, and check its name off the list.

E L T E E B E D B U G U B R E T A W

A F I R E B R A T E E B Y E N O H L

L G R A O H U D E F H C O A R O O A

O L W U T R B A R I T J H I U W R C

C O A S I D O C M R O W A S P R N E

U U L I U T G I I E M T E G L E E W

S S K T Q E F C T F V F N Z C P T I

T E I N S K A L E L L Y B A E P H N

A E N A O C K O Y Y G N A T D O S G

G B G M M A Y F L Y L F N R O H I A

U E S G E J R F F L L I O Z E E F D

B L T N Y W N G R F A F B H A E R I

Y B I I A O D I E R D E E C R R E D

D M C Y G L E W T E I V L N W T V Y

A U K A U L P R T E H Z A F O Y L T

L B R R N E O A U D P I L G R T I A

V D N P I Y R E B U A D D U M O S K

G R A S S H O P P E R T E K C I R C

Words to find:

ant
wasp
honeybee
cricket
hornet
locust
katydid
treehopper
oarworm
grasshopper
beetle
butterfly
moth
firefly
housefly
fruitfly
yellowjacket
firebrat
flea
bedbug
aphid
cicada
earwig
louse
hornfly
walking stick
deerfly
stonefly
dragonfly
waterbug
mayfly
gnat
earworm
mosquito
roach
ladybug
termite
bumblebee
lacewing
muddauber
silverfish

Name: _____

Bivalve Word Search

Reading forward, backward, up, down or diagonally, (but always in a straight line and not skipping any letters), you can find the names of 13 bivalves in the diagram below. To help, the names are given below. Circle the name of the bivalve in the puzzle when found, and check its name off the list.

C O M M U S S E L I L N O X U E S V

E X N I E V B L J U G I Q E V H T W

N O U C Z P O Y A S B M G Q L I T A

U J F R A N U T S T J O U A F N S N

M O H O K I M V C S G D Y J M G R P

B Z I S U C B I A P U N B N H E Z L

O N U C F A I O L J T S I P H A N Y

S T M O Z E V K L X C U F D O M U T

F I Y P B V A I O R A A N W H K B O

U F N I K Z L O P G T E Y W N U Y N

Z W O C R S V Q Z C O C K L E N I J

O V N O U A E W D N A I N Y C Q U B

T I S N T E E T H M X U C O K C L E

Words to find:

bivalve
byssus
cockle
foot
hinge
ligament
microscopic
mussel
neck
scallop
siphon
teeth
umbo

10-D

Name: _____

Mollusk Word Search

Reading forward, backward, up, down or diagonally, (but always in a straight line and not skipping any letters), you can find the names of 24 mollusks in the diagram below. To help, the names are given below. Circle the name of the mollusks in the puzzle when found, and check its name off the list.

M A D D U C T O R A D U L L A S

O A R S M O S R H I T Z R E D N

L Z B T B C H G I J U A F S O A

L B Q Y O K E E T V B T S P I

U D P U S L L N E K O C S U O L

S Q U I D E L I R L W N Y M R M

K E O V W X U P U M X T O M T U

S C A L L O P S T W H E L K S I

B I V A L V E E R N N N D E A U

S U P O T C O F E O O T F G G C

F I N H Z Y C D P P T A H M O R

H J E N O L A B A Q I C A I K E

K G M A B N E C K R H L M N L P

A D O P O L A H P E C E R O R O

L T N E M A G I L S Y P Q R S T

Words to find:

mollusks
bivalve
univalve
scallop
spine
whelk
adductor muscle
squid
chiton
cephalopoda
cockle
umbo
tentacle
triton
octopus
aperture
abalone
shell
ligament
oyster
snail
limpet
operculum
snail

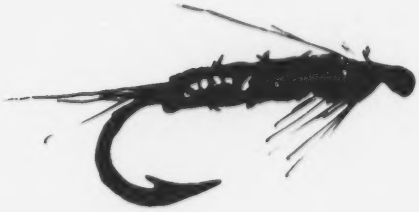
Name: _____

Fishing Flies

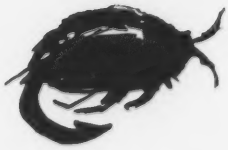
What insect is the fisher trying to copy? Draw a line from the fish fly to the insect it is copying. Write the name of the insect in the blank.

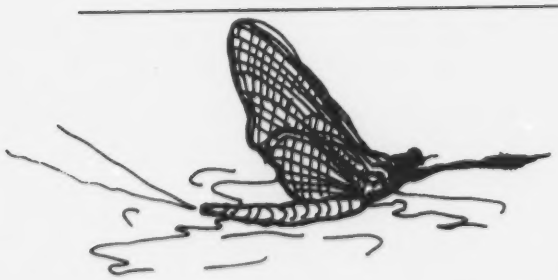
_____

_____



_____



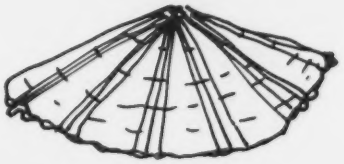
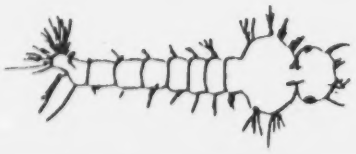
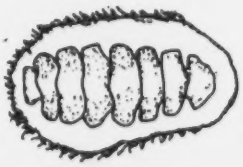
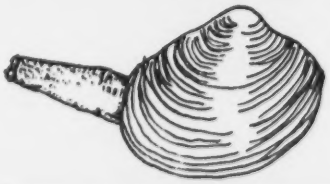
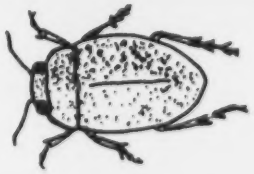


_____

10-F

Name: _____

Insect and Mollusk Squares

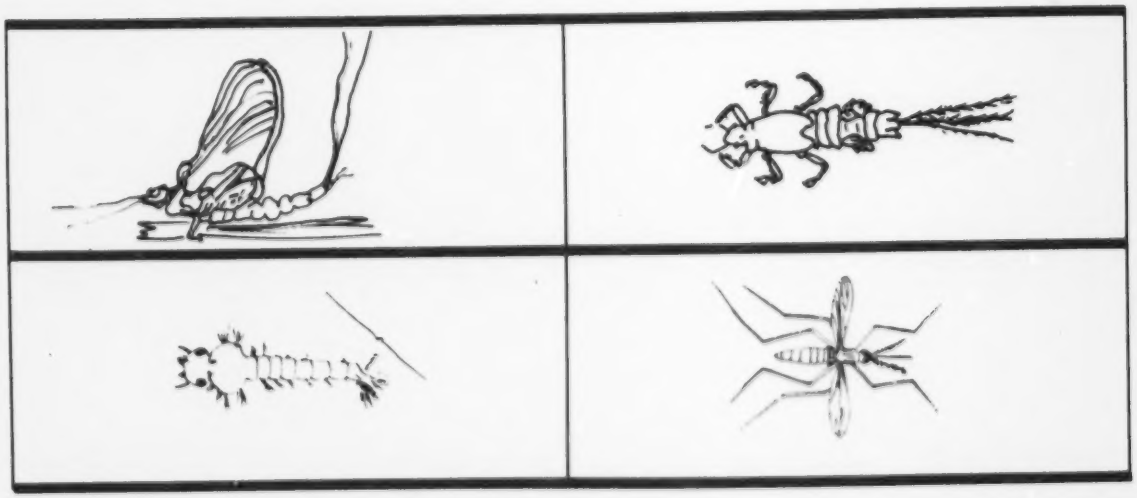
Mollusk	
	
	Insect
	
	
	

Name: _____

Insect Concentration

Directions

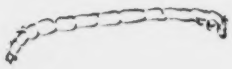
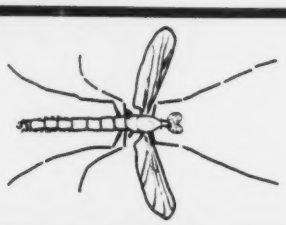
1. Paste the insect cards to stiff paper or cardboard.
2. Cut up the insect cards.
3. Turn the cards face down on the table in four rows of four, arranged randomly.
4. Play progresses around the circle.
5. Each player in turn chooses a card, turns it over and names the insect on the card.
6. The player then attempts to turn over another card with the same kind of insect on it.
7. If successful, the player takes the pair of cards.
8. The play continues to the next player whether or not the play was successful.
9. The game is over when all cards have been chosen and the winner is the player with the most pairs of cards.

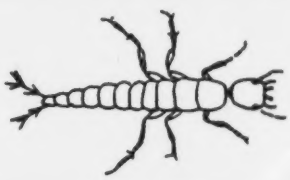


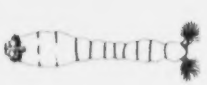
10-G

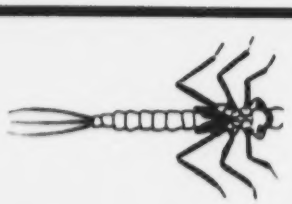
Name: _____

Insect Concentration





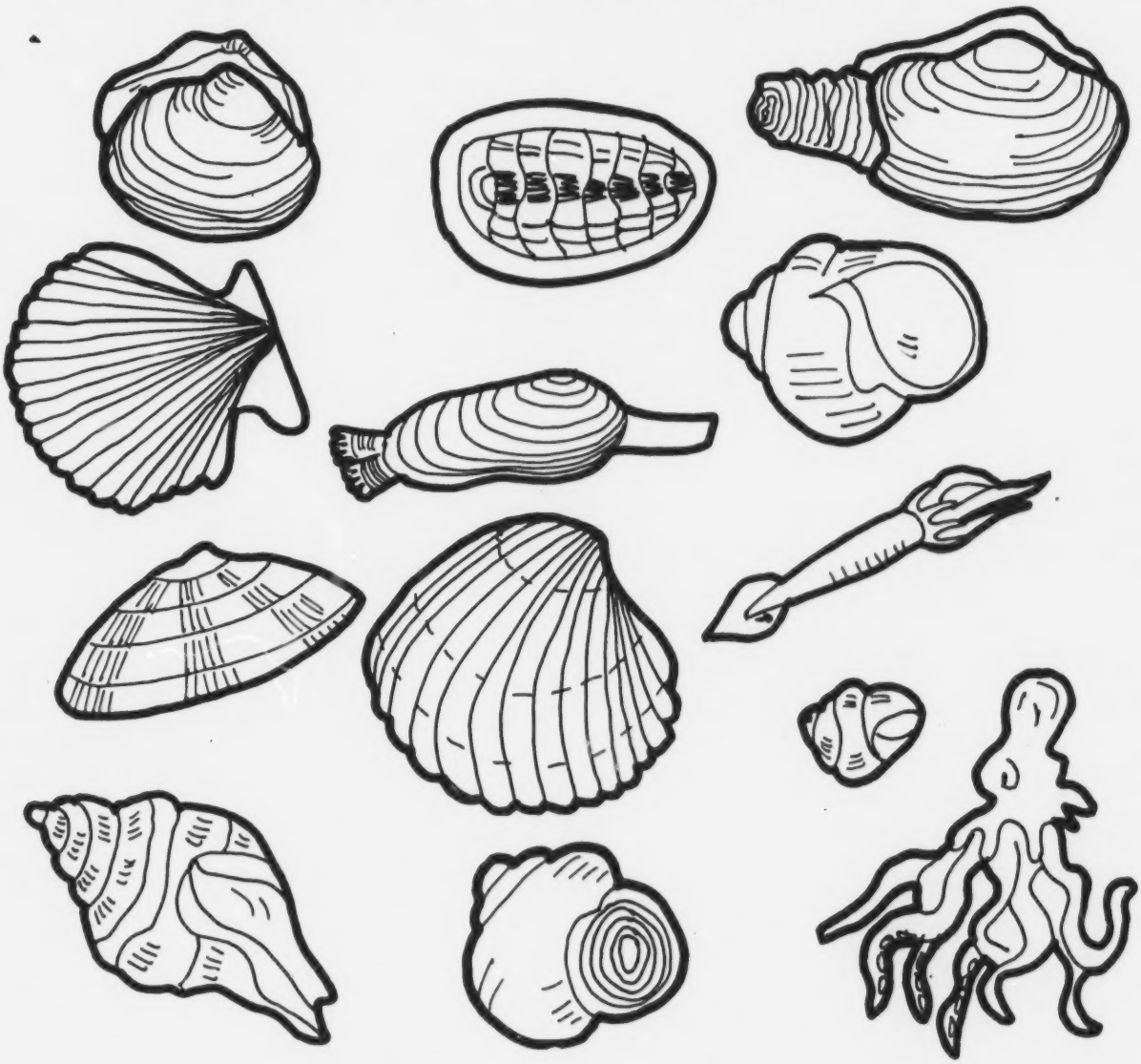


Name: _____

Color the Mollusk Review

Follow the directions:

1. Color the univalves pink
2. Color the bivalves green
3. Color the chitons brown
4. Put a black X on the mollusks
5. Put a green circle around the cephalopods



10-I

Name: _____

Mollusk Matching

1. mussels

2. clam

3. scallop

4. cockle

5. whelk

6. limpet

7. abalone

8. rock oyster

9. chiton

10. octopus

11. squid

Name: _____

Shell Treasure Hunt

List 3 different kinds of bivalves.

_____

_____

_____

List 2 univalves.

_____

_____

On the back of the paper trace the largest clam you can find.
On the back of the paper trace the smallest clam you can find.
What kind of shell has a round hole drilled in it?

_____

Who made the hole?

_____

Find a rough shell.
Find a smooth shell.
Find something old.
Find something new.
Write down the name of your favorite shell.

_____

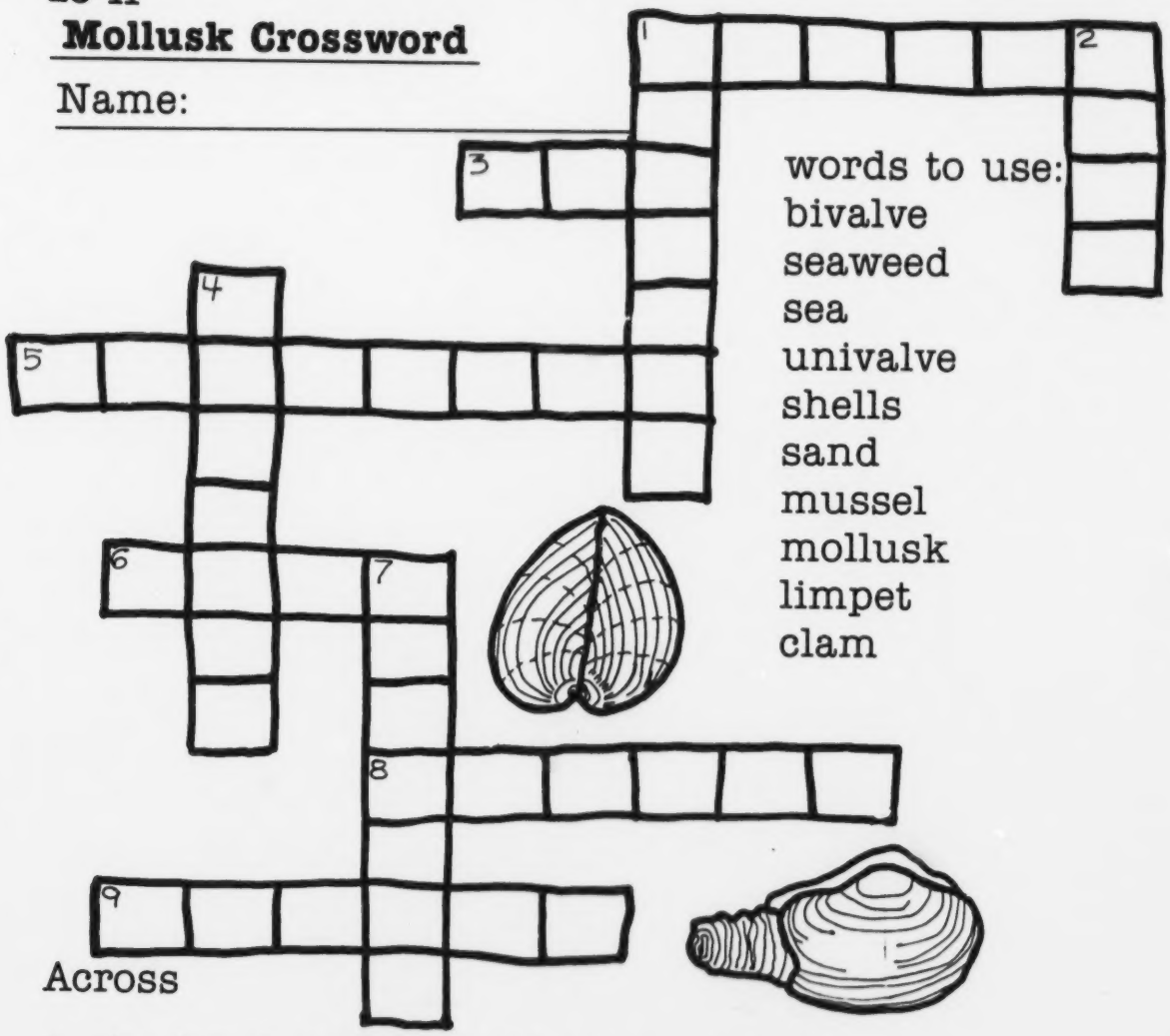
Which shell looks happy?

_____

10-K

Mollusk Crossword

Name:



words to use:
bivalve
seaweed
sea
univalve
shells
sand
mussel
mollusk
limpet
clam

Across

1. the hard coverings of a sea animal
3. a large body of salt water
5. snail with one valve to its shell
6. a univalve shell shaped like a Chinaman's hat
9. a kind of clam that has a bluish black shell

Down

1. a plant that grows in the ocean
2. tiny loose grains of crushed rock and shells
4. a mollusk with 2 matching shells and a hinge
7. an animal that has no backbone and has a shell to protect its soft body

Name: _____

Sea Week Puzzle

Directions:

Write the numbers 1-26 in a long line. Write the letters of the alphabet under the numbers.
1 = A 2 = B etc.

1	2	3
a	b	c

The groups of numbers below make words.

Place the right letter under each number.

What is the message?

19, 8, 5 19, 5, 12, 12, 19 19, 5, 1

19, 8, 5, 12, 12, 19 2, 25 20, 8, 5

19, 5, 1 19, 8, 15, 18, 5

Make your own message here. Give it to a friend.